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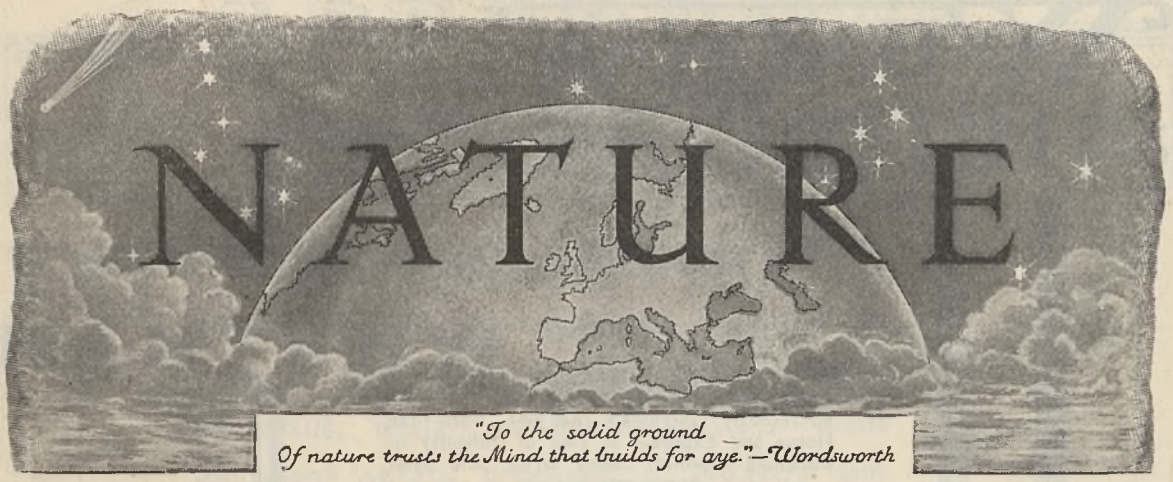

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INFORMATION SERVICES AND SOCIAL SURVEY

IN the debates and discussions regarding the termination of the Ministry of Information, either in Parliament or elsewhere, there has been little recognition of the importance of information services in a democratic government, both from the point of view of keeping the Government informed of the state of public opinion, and of keeping the public adequately informed on the many matters in which government action impinges directly on their daily lives. The Prime Minister has indeed admitted that such services have a permanent place in the machinery of government, but there can be no doubt that had this point received more attention in framing and executing policy, much of the friction and opposition engendered by the restrictive measures introduced by the Government might have been avoided. It will be remembered that in one of its reports the Select Committee on National Expenditure, recording its view that the War-time Social Survey of the Ministry of Information was an essential service, recommended that the Survey should be used for factual inquiries which are necessary to guide a Ministry in some particular policy, and that the Survey itself should be placed under the authority of the Lord President of the Council rather than of the Ministry of Information.

It has in fact become, as a P E P broadsheet observes, "absolutely vital that the state and all organisations whose business it is to serve or control the public should have an accurate knowledge of the ways of thought and action and of the environment of the people for whom laws or service are intended". The social survey is one instrument still in the early stages of development by which this vital social information can be obtained, to assist—but not to relieve—the administrator in his responsibility for wise judgment in the interests of the nation and for providing leadership. According to the Prime Minister's statement on March 7, the Central Office of Information is to be placed, with the machinery of integrating and co-ordinating departmental information policy and action, under the general supervision of the Lord President of the Council, and the Civil Estimates for 1946–47 include, in a vote of £2,631,300 for the Central Office of Information, £63,000 for the Social Survey.

The broadsheet already mentioned (No. 250, "The Social Use of Sample Surveys") contributes much more than a valuable analysis of the work of the Social Survey: it discusses the need for co-ordination and for establishing recognized standards of technique, which would avoid the wastage of valuable social data and also the initiation of overlapping, unnecessary or amateurish surveys. Primarily, the broadsheet is concerned with surveys of social habits and environment, although the survey of opinion is not altogether neglected. It points out that the state of public opinion is one piece of evidence to be considered in framing policy, and not necessarily the most weighty element, as indeed the food situation in Great Britain

illustrates. If, however, surveys of opinion are to become a feature of normal democratic machinery, it will be necessary to watch closely for what purposes these surveys are used, and to relate this practice to the general philosophy of British democracy, which has normally rejected the plebiscite or referendum as a piece of constitutional machinery.

Since the Select Committee on National Expenditure reported in February 1942, the survey method has become a social research unit the services of which are regularly used by many departments, and *Planning*, in assessing the significance of survey methods, emphasizes the danger of excessive claims. A social survey is defined as an objective and unbiased investigation of habits, environment or views of a group of people. As such it can never replace censuses, although in practice its beginning can be seen in the work of Defoe, Cobbett, Howard and Chadwick, long before Charles Booth's "Life and Labour of the People of London". It should be noted, too, that well-informed critics are rarely concerned with errors which might arise in surveys solely because of the use of sampling, provided the sampling and analysis is well done.

The P E P broadsheet gives an admirably concise review of the surveys already conducted in Britain before discussing the scope of sample surveys, the objections usually advanced against them and the technique employed. It is from this lucid assembly of facts establishing beyond question that the social survey is an essential tool in social policy and in government policy that *Planning* proceeds to consider future public policy on surveys.

While it does not follow of necessity that a social survey unit should be maintained as part of the government machine in Britain, there are strong arguments in favour of this course. Government demands are likely to be considerable in view of the extensive programme of social and economic reform which faces us; and it is unlikely that a university or a commercial organisation or any other outside body will always be ready to undertake a suitable project on behalf of the Government when such work is needed. Moreover, experience as well as money is wasted if staff has to be collected for each survey and is dispersed again when the particular work is completed. Accordingly, P E P recommends first that a survey unit for carrying out social survey work on behalf of the Government should be retained and attached to the machinery of government, possibly to the Central Office of Information, particularly as the connexion of that body with the Lord President's office, which is concerned with scientific research rather than administration, will now emphasize a scientific approach to survey work. With this, however, is needed co-ordination of government statistical work, both in the field of sample survey and in work such as that of the Central Statistical Office and the forthcoming censuses of production and distribution. Common use of the expensive calculating and card-punching machinery should also be arranged.

According to P E P, however, there is no reason for insisting that all government work should be carried out through such a Government survey unit. Commercial organisations or universities may sometimes have specialized experience which will be of particular value for special work. Some form of competition will provide a healthy stimulus to both sides, and occasionally when two or more surveys may be required by the Government simultaneously, additional help may be needed. Again, an individual department may on occasion be able to give valid reasons for carrying out a particular survey with its own staff. For such reasons, while the Government would naturally keep its own survey unit fully occupied, it should have complete freedom to initiate survey work through any selected organisation.

The Government survey unit itself should not, in the opinion of P E P, be confined to special surveys undertaken for particular legislative or administrative purposes. It should be able to initiate more general research, for example, on problems of sampling, long-term trends in migration, changes in the circumstances and habits of various social groups. Some of this work can, of course, be undertaken already by universities and other bodies; but there are fields in which research is badly needed but which cannot be tackled owing to the expense involved and the lack of any immediate commercial consumer for the information which might be obtained. In these fields the Government unit could very clearly make a contribution in the public interest, but P E P is undoubtedly right in urging that it is desirable that such basic research should be undertaken only if the academic and other organisations in the same field agree as to the necessity for the work to be done.

Full consultation should come first, and accordingly the broadsheet suggests that some machinery for consultation should be provided. Its second recommendation is in fact that the Government should initiate conversations with the universities, scientific and social institutions, commercial organisations and others concerned in the field of social survey to consider what action should be taken, whether by the creation of an institution or otherwise. Since, however, many local authorities are anxious to undertake surveys in connexion with their housing and other plans in the post-war period, while universities and charitable trusts will wish to continue survey work of their own in connexion with particular social and economic studies, some adequate machinery is needed for co-ordinating such efforts, for standardizing technique so far as is advisable, and for probing and analysing the results of independent research work. Moreover, some of the research on consumption carried out by commercial organisations may overlap with surveys of this type and could yield more valuable results if correlated so far as units of measurement or definitions, for example.

In addition to providing a source of competent, professional advice on the planning and execution of social surveys, particularly for local authorities and similar bodies intending to undertake a survey, the broadsheet suggests that such a central institution could maintain a register of all projects for sample surveys, by the Government, the universities or commercial organisations in order to direct attention to duplication or any links which could easily be pro-

vided, as well as to collect and collate the results of at least those surveys which are not necessarily kept confidential for purely commercial reasons. In addition to maintaining records of the results of surveys and undertaking a comparative analysis of the results on occasion, a central institution could advise on the framing of questionnaires, the training of interviewers, and the technique of execution and analysis. The broadsheet also suggests that it could promote good standards of work and good relations with the public, and provide a forum for the interchange of information, both as to projects, technique and results, for example, by the publication of a journal reviewing work being carried out in Great Britain and making available details of international work, and by holding annual or other periodic conferences of those engaged in survey work and publishing the proceedings.

While *Planning* advances this list of some of the functions which could be undertaken by a central institution, it does not at this stage recommend that they should all be undertaken immediately, or that they should all be undertaken by a single organisation. Its recommendation is rather, as already noted, that the Government should initiate conversations with those concerned in the field of social survey to consider what action should be taken. Moreover, while *Planning* is concerned in this broadsheet solely with the social survey and not with the whole field of social research, laying down as one principle that any new organisation should be concerned solely with the social survey, with terms of reference as specific as possible without unduly limiting the field of action, it deals also with two points that the Clapham Committee on the Provision for Social and Economic Research appears to have overlooked in its report. Neither the detailed study of the use made by Government of its own research workers in this field, nor the use which could be made of independent research bodies, appears to have been considered by the latter Committee.

On the first point, the recommendations of P E P have already been noted; and it need only be observed further that examples of duplication and overlapping between the regional research officers of the Board of Trade and the Ministry of Town and Country Planning could easily be cited. On the second point, P E P is clearly fully alive to the potentialities of the independent research organisations, such as the National Institute of Economic and Social Research, the West Midlands Group, the Northern Industrial Group, the Association for Planning and Regional Reconstruction, apart from the interest, for example, of the Royal Statistical Society. Consultation with such interested parties should be the first step towards a precise recommendation as to the constitution of any new organisation.

Beyond this, P E P emphasizes that it is desirable that any such institute or other organisation should not be within the Government itself. Stress is rightly laid on the undesirability of canalizing within any direct government control the scientific work which is developing directly and experimentally. The establishment of a network of national and regional research associations which might represent in the economic field the equivalent of the research associations of the Department of Scientific and Industrial Research, as suggested in the *Economist* in commenting on the Clapham Report, might well encourage the free interchange of ideas between all kinds of organisations and individuals, and be free from the inherent defect of the industrial research association itself. If it could be done informally, the required co-ordination might thus be secured without an undesirable degree of control. Equally, however, any organisation established must have adequate funds and would almost certainly require a Treasury subsidy, or endowment by a charitable trust. A first step might, for example, be the endowment of the exchange of information on work in progress at present undertaken by the National Institute for Economic and Social Research.

This P E P broadsheet, therefore, makes a useful complement to the Clapham Report, the basic argument of which as to the need for more factual inquiries it strongly supports, both from the point of view of the social services themselves and also from that of the public benefit derived from applied social research. Neither document, however, emphasizes one factor which must be remembered if the fullest benefit is to be derived from the social survey, still more from the extended provision for social and economic research recommended by the Clapham Committee—the need for economists to utilize experience from other fields. The detailed studies of problems on the boundaries between economics and other sciences—for example, an examination of the trend of technical efficiency in British industry—involve contributions from the engineer, the statistician, the accountant, the social historian, the personnel manager and the industrial psychologist. One of the main problems is not the organisation of co-operation between social scientists in the strict sense, important as that aspect may be in view of the urgent need for making the utmost use of man-power, so much as the organisation of that effective collaboration between workers following different disciplines in the attack on common problems. If the social survey can be handled so as to promote such co-operation and mutual understanding, it will prove not merely an indispensable tool of government, but also a most effective instrument for the stimulation of that creative thought at the boundaries of knowledge which again and again has proved the precursor of the advance of science.

GENETICS IN THE U.S.S.R.

The New Genetics in the Soviet Union

By P. S. Hudson and R. H. Richens. Pp. 88. (Cambridge: Imperial Bureau of Plant Breeding and Genetics, 1946.) 6*s*. net.

FOR more than ten years, biologists have been puzzled by reports from the U.S.S.R. about the 'new genetics' of Lysenko and his school. According to these reports, Lysenko had repudiated Mendelism, and in its place he had established a new genetics, founded on the authority of Darwin and Michurin, and elaborated from his own experiments. The new

genetics took no account of segregation. It did not admit phenotype or genotype. It denied that chromosomes played any special part in heredity. It claimed that inherited characters were transmitted through the sap from stock to scion in grafts. It demonstrated that in open pollination, picturesquely called 'love marriage', the ovum selects the gamete it desires. It contrasted the outward appearance of a plant (called its 'shirt') with its physiological character (called its 'soul'). It condemned the work of Mendel, Bateson and Morgan as clerical, bourgeois-capitalistic and fascist. It disdained the use of statistics, controls and such-like experimental techniques. It fought its way to recognition with the weapons of the medieval schoolmen: appeal to authority; *a priori* assumptions based on dialectical materialism; and the compelling pragmatic test that, by the new genetics, nurture henceforth takes charge over nature.

This intellectual eruption, needless to say, severely shook Soviet biology. There was a period during 1932–40 of bitter controversy. Vavilov and Karpechenko vanished during the fight. Serebrovsky and Dubinin retired disillusioned to their institutes. But Lysenko received the applause of the Soviet press and was awarded various public honours. It seemed to biologists outside the U.S.S.R., who were unable to weigh the issues for themselves, that the new genetics had ousted the old.

Lysenko writes in such an obscure style that a knowledge of Russian alone is quite inadequate equipment for a study of his views; one needs to know also something about the Russian character, and something about the application of dialectical materialism to science. Dr. Hudson and Mr. Richens have all these qualifications, and they have written an important essay, in which they summarize in a masterly way the philosophical and psychological origins of Lysenko's views, the experimental evidence, and the logic (or lack of it) used to interpret this evidence. Fantastic as Lysenko's claims may appear to British biologists, they nevertheless deserve careful examination—we did, after all, overlook Mendel for thirty-six years. Hudson and Richens have disengaged the problem from all the violent prejudices which surrounded it. They have approached it in the best traditions of scholarship; important quotations are even reproduced in the original Russian in footnotes, and there is a summary in five languages. They are most sympathetic to Lysenko. They are so anxious to do him justice that they excuse his naïve terminology and his ignorance of contemporary genetics; and they are almost orientally apologetic every time they bring a verdict against him. Thus on the question as to whether Lysenko's evidence for 'love marriages' among mass pollinated plants is convincing, they conclude: "it is difficult to come to any answer other than a decided negative". The whole essay is a virtuoso piece of literary meiosis. Lysenko could not have had his case put more fairly: indeed, he could not have put it nearly so fairly himself.

And what is his case? Hudson and Richens show how the new genetics has its source in Darwin, often from some tentative suggestion Darwin made; so that Darwinism in Russia means something quite different from Darwinism in England. They show how Darwin's views have been clothed in the language of dialectical materialism. They record how, in 1932, a resolution was passed in Leningrad that genetics and plant breeding were to conform with dialectical materialism, so that Lysenko enlisted the State on his side. They give the most objective account ever written in English of the controversy during 1932–40. They examine the argument by authority and the denunciation of the seven heresies of genetics. They describe Lysenko's use of the "elastic hypothesis" which contains all the facts you like and explains none of them. They review the experimental evidence for the control of heredity by environment, and they reluctantly decide it is "not compelling". They discuss Lysenko's interpretation of this evidence, and they register gentle but firm disapproval. They give a résumé of Lysenko's destructive attack on Mendelism.

In spite of the authors' urbanity, the new genetics emerges from this essay in a pretty bad state. Lysenko claims to have changed heredity by manipulating the environment and to have rejuvenated pure lines by intravarietal crossing: the authors show that his experiments are capable of other interpretations quite consistent with the old genetics. Lysenko claims to have influenced the heredity of plants through grafting: the authors show that his data are incapable of any interpretation, and that one of his tables is even inconsistent within itself. Lysenko claims to have demolished the old genetics: the authors show that his criticisms are applicable only to the genetics of thirty years ago. Lysenko's attitude to modern genetics outside his own school is (as I know through conversation with him) one of militant obscurantism. Hudson and Richens, by contrast, have analysed the most improbable claims of the new genetics with quiet care; and they even support Lysenko's just complaint that other geneticists have not taken the trouble to repeat his experiments.

The authors point out that they cannot offer opinions on two matters of interest: the exact way in which Lysenko does his experiments, and the present state of the new genetics in the U.S.S.R. I can offer some comment on these two matters.

First, as to the experimental technique in the new genetics. The experiments are carried out on very small populations of plants. For example, an experiment on 'shattering' the heredity of winter wheat (to turn it into spring wheat) occupies a plot of ground about 7 ft. by 3 ft. An experiment on changing the nature of Wohltmann potatoes occupies two rows about 20 ft. long: one row, the control, is heavily infected with virus, though this was denied by Lysenko. An experiment on 'love marriage' in rye occupies about 7 ft. by 3 ft. of ground. Experiments on the transmission of heredity through grafts, using tomatoes, are done with about 20–30 plants, sometimes without controls. The technique of emasculation seemed unreliable to me; and I was told by Lysenko that it is only since 1940 that emasculated flowers have been bagged before pollination; before that no precautions were taken to exclude stray pollen. Since Lysenko rejects the idea of pure lines, no particular care is taken to use homozygous material for experiments; in fact, Lysenko seems to assume that any variety with a name to it is genetically homogeneous—an assumption which should not be made for Russian varieties. Some of the strains of tomatoes are markedly heterozygous, and some suffer from spotted wilt, which causes a mottling of the fruit which Lysenko attributes to a change in heredity. When experiments are carried into an F_2 generation, not all the seed from a parent plant is sown, but only seed from 'selected' fruits or ears. Statistical treatment

of the data is forbidden ; it was a member of Lysenko's staff who told me that Darwin's work is convincing without statistics ; why should anyone require statistical evidence of Lysenko's work ?

As to the present state of the new genetics in the Soviet Union, it is safe to assume that Lysenko's school is well past its zenith. It is true that he is still a great demagogue among the peasants and on the collective farms. It is true that, in the University of Leningrad, Turbin (who has the chair of genetics) and Prezent (who has the chair of Darwinism) maintain a school of the new genetics, and Sinnott and Dunn's text-book is passed in secret from student to student as though it were an inflammatory tract ; and Lysenko has tried (see his journal *Yarovizatsia*, 1939 and 1940) to suppress all teaching of Mendelism in Russia. But side by side with the new genetics there exists, in uneasy truce, a school of the old genetics which is setting the pace on world standards in such fields as population genetics and the use of colchicine-induced polyploids in plant breeding. The University of Moscow has flourishing genetics schools under Serebrovsky and under Schmalhausen, where Khvostova has recently repeated Lysenko's work on graft hybrids in tomato and shown that his results are due merely to heterozygosity. It is fairly safe to say that most biologists in the U.S.S.R., while ready to admit Lysenko's skill as a practical agriculturist, are deeply embarrassed by the new genetics, and are gradually turning their backs on it.

There are very few matters for criticism in this essay by Hudson and Richens : only a few minor errors not worth special mention ; and a mild complaint at the scholarly but rather fastidious transliteration of Russian names into unfamiliar English equivalents. The authors have done a great service to international understanding in biology. They hope their work will remove prejudice on both sides. That is perhaps too much to hope ; but if it exposes the new genetics as a throw-back to the days of Thomas Aquinas, it will undoubtedly be welcome, and not least in the U.S.S.R. itself. ERIC ASHBY

REGISTRATION OF ORGANIC REACTIONS

Synthetische Methoden der organischen Chemie
Von W. Theilheimer. Repertorium 1. Pp. viii + 224. (Basel und New York : S. Karger, 1946.) 25 francs.

THESE are days of registration and regimentation, and even organic chemistry cannot escape. The increasingly rapid expansion of this branch of science, since the inception of the Kekuléan theory of organic molecular structure in 1858, has been marked by a bewildering accumulation of organic compounds and reactions.

The systematic registration of the 'monstrous regiment' of new compounds, produced in their hundreds of thousands by a mounting army of research workers, has been well accomplished in such works as Richter's "Lexikon der Kohlenstoff-Verbindungen" (3rd edition, 1910–12), Beilstein's "Handbuch der organischen Chemie" (4th edition, 1918–39), and Heilbron and Bunbury's "Dictionary of Organic Compounds" (2nd edition, 1943). As a result of the Second World War, however, the monumental and invaluable Beilstein—"the Charlie's Aunt of organic chemistry"—has been halted in its course, and now lies stranded far behind the rushing tide of new compounds. Here, fortunately, the position is ameliorated by the regular publication of various series of chemical abstracts of current literature.

The effective registration of organic reactions has reached a far less satisfactory position than that of organic compounds. Earlier generations of researchers hailed with delight and relief, even in the days when the technique of organic chemistry was comparatively simple, the issue of successive editions of Lassar–Cohn's "Arbeitsmethoden für organisch-chemische Laboratorien" (1890, 1893, 1903 and 1907). Later on, this was followed by Houben–Weyl's massive work in four volumes, entitled "Die Methoden der organischen Chemie" (2nd edition, 1921–24). In recent years, owing more to the accumulation of fine detail concerning known reactions rather than to the discovery of essentially new ones, the task of carrying out a quick and effective survey of knowledge in this field has grown ever more difficult. Several attempts have been made to remedy the position by issuing serial works on organic synthetic methods, among which may be mentioned in particular two valuable American publications : (1) "Organic Syntheses : an Annual Publication of Satisfactory Methods for the Preparation of Organic Chemicals" (1921, onwards), and (2) "Organic Reactions" (Vols. 1 and 2, 1942, 1944). Each annual volume of the first work contains authenticated particulars for a haphazard collection of compounds ; each volume of the second work is a "collection of about twelve chapters, each devoted to a single reaction, or a definite phase of a reaction, of wide applicability".

Dr. Theilheimer's new venture is of still another type, for his object is to undertake periodically a systematic registration of new synthetic organic reactions and also of adaptations and extensions of known methods to be found in the current literature. This is a novel project with great potentialities. In the first volume, now under notice, the literature of 1942–44 is reviewed ; a second volume is projected to cover the years 1945 and 1946 and to gather stray references from the years of the Second World War ; and further volumes will then follow at yearly intervals.

As there is no generally accepted classification of organic reactions, the author has worked out a tentative system of his own, based ultimately upon the characters of the new linkages formed in the reactions concerned. Four major ways of forming such linkages are recognized for the purpose of the classification, namely, uptake (*Aufnahme*), rearrangement (*Umlagerung*), exchange (*Austausch*), and elimination (*Abgabe*). Each type of process is represented by a special symbol, and still other symbols are used to indicate ring-closure, ring-fission and electrolysis. In all, the work contains notices of 793 reactions, with brief indications of experimental conditions and yields and references in each case to the original literature. A systematic summary of these reactions is given on a single page at the end of the volume, and there is an ordinary index for readers who may not take kindly or easily to the author's new system of representation. As an indication of the comprehensive scope of the work, it may be noticed that the index entries given under the heading "Ketone" exceed fifty. The work will be examined with keen interest by research workers in organic chemistry ; but experience only can determine whether the system of registration will find general acceptance, although there can be little doubt that something of the kind is much to be desired. JOHN READ

AMERICAN TECHNIQUES IN PHYSICAL CHEMISTRY

Physical Methods of Organic Chemistry

Edited by Arnold Weissberger. Vol. 2. Pp. vii + 737–1367. (New York: Interscience Publishers, Inc., 1946.) 8.50 dollars.

VOLUME 2 of this series of reference books has the same general merits and defects as Volume 1, which was reviewed a short time ago (*Nature* of May 11). It includes, however, a decidedly larger proportion of those physico-chemical methods which are capable of wide and novel application in the very fields of organic chemistry which are at present undergoing the most rapid development, and therefore may prove to be much the more useful of the two volumes.

It is apparent again that different contributors have treated their selected subjects in styles which range from highly detailed accounts of physical principles and apparatus to more general outlines of principles which are then illustrated by experimental methods chosen so as to show the scope of the particular technique. In the opinion of the reviewer, this latter approach is the better one from the point of view of the general reader.

As extremes in treatment one may contrast the article on 'polarimetry' by W. Heller, which, in a hundred pages, deals only with the physics of double refraction, and with the principles of different designs of polarimeters, with two much more concise articles by L. Michaelis on potentiometry and on the determination of magnetic susceptibility. These include no more than the essential minimum of physical theory, describe only the essential features of typical apparatus, and then concentrate on showing the scope and importance of accurate measurement of, for example, hydrogen-ion potential, oxidation-reduction potential, or the evaluation of magnetic moments.

A brief article on mass spectrometry by D. W. Stewart is again valuable for showing the applications of this subject in the examination of organic substances subsequent to isotope exchange, and in the analysis of complex mixtures of hydrocarbons.

Two articles by W. West on spectroscopy and spectrophotometry, and on colorimetry, photometric analysis and fluorimetry, strike quite a good balance between the space allocated to physical principles and apparatus and to indications of the applicability of these methods. In view of the great and growing importance of all these techniques in both organic and inorganic analysis the editor might, with advantage, have allocated more space to each of these articles. The many inherent dangers, as well as the advantages, of adducing information from spectroscopic or colorimetric data might then have been set forth more clearly.

Accounts of conductometry by T. Shedlovsky, and of determination of radioactivity by W. F. Bale and J. F. Bonner, Jr., deal essentially with physical apparatus, and with the precautions needed for the attainment of high accuracy, rather than with the value of such measurements. In the latter case this is especially to be deprecated, in view of the very important uses of radioactive isotopes in biological chemistry. For reference purposes, however, both articles are useful sources of exact information. The same unfortunately cannot be said of an article by C. P. Smyth on dipole moments, which fails badly on account of its quite inadequate length.

A hundred-page article on polarography, by O. H. Müller, attempts to review the especial applicability of this important technique in relation to problems of organic chemistry, but gives on the whole a rather confused impression of the complexity of the subject, making it evident that polarography is still in such an early stage of development that newcomers to the technique would be well advised to start by learning its first principles in the simpler field of inorganic analysis. Müller very wisely describes the construction and use of simple polarographic apparatus and merely indicates the existence of manufacturers' automatic outfits.

Though every reader of these two volumes will, like the reviewer, find much to criticize therein, he is sure to find himself making continual use of them when in need of precise information concerning modern physico-chemical apparatus. "Physical Methods of Organic Chemistry" should certainly be included on the reference shelves of any chemical research laboratory.

W. A. WATERS

ITALIAN RADAR

Introduzione alla Radiotelemetria (Radar)

Apparecchi e nozioni entrati nell'uso corrente. Per Prof. Ugo Tiberio. Pp. 277. (Roma: Editore Rivista Marittima, 1946.) 300 lire.

IN view of the outstanding achievements of Britain and the United States in radar development, it is at first sight somewhat surprising that the first serious text-book on radar to be published should come from Italy. When we consider, however, that for Italy the War finished a good eighteen months before it ended for us, it is not difficult to see that scientific men in that country have had more time to write of their work than British men of science, and have been less concerned with difficulties of security. Indeed, there are several British and American books on radar technique under way which take the development of the subject far beyond the scope of the present book, and these will be looked for with interest by a wide variety of readers. For the radio engineer, of course, British developments have been made available in the excellent series of papers submitted to the recent Radiolocation Convention held by the Institution of Electrical Engineers.

The present volume is mainly of historical interest as it gives an account of the Italian research on radar from 1935 to the end of hostilities. Some of their radio-frequency technique, which now seems crude, was in the days before the War quite advanced. The advances made during the War, however, appear to be small, and how much came from German sources is difficult to ascertain. The book deals mainly with radar used on the ground and on ships for early warning of the approach of aircraft and of ships and for fire control. For early warning, wave-lengths in the region of 1½ metres were mainly used, and for fire-control advantage was taken of the higher definition obtainable by the use of higher frequencies. Although experiments seem to have been made on a wave-length of 10 cm. using klystrons and split-anode magnetrons, most of the equipment in use appears to have operated on wave-lengths of the order of 70–80 cm.

There is no mention of high powers in the centimetric band such as were used in British and American radar.

Surprisingly, too, there appears to have been only slight appreciation of the technique of using a single aerial for transmission and reception. Such notable advances as the 'plan position indicator', used for forming a 'radar' map, seem also to have been missed.

The part of the book dealing with the elementary principles of radar will be of most interest to readers other than radio engineers. The treatment is simple and lucid, though rather sketchy. In particular the effect of the earth on aerial polar diagrams is very fully dealt with.

The main defect of the book is its complete lack of photographs. One gets a much better idea of the state of technical development from a photograph than from a bare circuit diagram. The performance of radio equipment in the ultra-high frequency region depends so much on engineering technique and lay-out that very little impression of the quality of the equipment can be obtained without a picture. There is a vast gap between a schematic idea and a finished operational equipment. There is little to indicate that that gap was often filled. R. A. Smith

INFRA-RED AND RAMAN SPECTRA

Infra-Red and Raman Spectra of Polyatomic Molecules

By Prof. Gerhard Herzberg. (Molecular Spectra and Molecular Structure, Vol. 2.) Pp. xiii + 632. (New York : D. Van Nostrand Co., Inc., 1945.) 9.50 dollars.

IT is now becoming more widely realized that infra-red spectroscopy has grown into a powerful new method for analysis and structural diagnosis, and as such it must be used by many who have hitherto had little knowledge of either the relevant theory or the experimental technique. To this extent any new book on the subject will be studied with interest. Prof. Herzberg's new monograph on polyatomic molecules, like that on diatomic molecules preceding it, is an admirable one. It is important, however, to understand just what this book sets out to cover, since in spite of its very great value it cannot, taken alone, be regarded as a manual for new workers in the field.

Until about ten years ago, most infra-red measurements were directed at the elucidation of spectral theory and the determination of molecular structure. The large number and arrangement of the energy-levels of even the simplest polyatomic molecules are far more complex than with diatomic molecules, and the selection rules which determine the possible transitions between the levels are also more involved. If it is possible to derive the energy-levels from the spectral data, important structural properties such as the moments of inertia and vibrational frequencies are obtained, and even a partial analysis may provide enough information from which many of these quantities can be determined. For such analyses, and particularly in the assignment of vibrational frequencies, a correlation of the infra-red spectra on one hand and the Raman spectra on the other may be not only valuable, but essential, if a complete solution is to be reached.

The present book provides the most exhaustive and polished discussion of these matters yet published, and is amply illustrated by many examples of molecules which have actually been studied. As is well known, the symmetry properties of molecules play an important part in determining not only the arrangement of the molecular vibrational and rotational energy-levels, but also the selection rules. Prof. Herzberg has wisely devoted much care to a lucid account of characteristics of symmetry, with excellent illustrative diagrams. There is a thorough account of the nature of the potential energy function for molecular vibrations and of the methods for calculating the vibration frequencies in terms of the nuclear masses and force field within the molecule. Experienced spectroscopists will welcome this lucid survey of a highly complex problem, and will agree about the clarity with which the author has prepared it. There follows a detailed account of internal torsional motions, inversion doubling as found with ammonia, the relationships between the vibrational frequencies of isotopic molecules, and other related matters, and there is a valuable compilation of the results for most molecules so far examined.

The rotational fine structure associated with different kinds of vibration band is then considered by reference to molecules in different symmetry classes, and complications resulting from interaction between molecular vibration and rotation are considered in some detail. Here, too, the book will be regarded as a work of reference for many years to come. For molecules with somewhat larger moments of inertia where the rotational fine structure of the vibration bands cannot quite be resolved, the envelope of the structure can frequently be useful, and the possible types are briefly mentioned.

In a final short chapter, some applications are considered, and the methods of computing thermodynamic functions from spectroscopic data are summarized. The bibliography and index are good.

In all the above connexions, which really involve the various problems of molecular dynamics, there can be little but praise for the thorough way in which the author has set out the work, and any reader who wishes to understand the fundamental principles of the subject could find no better guide. On the other hand, the emphasis seems now to be passing to the more chemical applications, where more complicated molecules are involved. As a rule these molecules possess no symmetry, have large moments of inertia, and can be examined only in the liquid or solid state. At present, interest centres for the most part on the correlation of vibrational spectrum with the presence of internal molecular groupings, and such correlations can only be made by a semi-empirical method of comparison using related groups of molecules. There is now reason, moreover, to hope that more can be learnt from the spectra of solids and liquids about the intermolecular forces, and the technique is being applied successfully in the study of crystals and macro-molecules. The molecular dynamics of long-chain molecules, too, introduces a somewhat different problem from those considered earlier. These newer aspects are treated only briefly in the present book, which may in this respect therefore be less directly useful to the technologists. There is also little mention of the whole new field of infra-red analysis, nor any account of the experimental methods which have so rapidly improved during recent years.

These omissions do not at all affect the masterly presentation of the particular topics with which the author has dealt. Indeed, it may be that to lengthen the book would have been a disadvantage. Certainly all spectroscopists will want to refer to it, and many will regard it as a close companion.

H. W. Thompson

TERCENTENARY OF JOHN FLAMSTEED (1646–1719)*

By Sir HAROLD SPENCER JONES, F.R.S.
Astronomer Royal

TO-DAY [August 18] we commemorate the tercentenary of the birth of John Flamsteed, the first Astronomer Royal and one of the greatest practical astronomers of his day. I am glad to have the opportunity to pay a tribute to the first of my predecessors, who laboured with single-minded devotion at Greenwich for forty-four years. It is appropriate that this commemoration should be held in this church : for Flamsteed held the living of Burstow for thirty-five years, he paid frequent visits here, and in the chancel of this church he lies buried.

John Flamsteed was born at the village of Denby, several miles northward from Derby, on August 19, 1646. His parents were, in his own words, "of known integrity, honesty and fortune, as they were of equal extraction and ingenuity". When barely three years old he lost his mother, his father being left with the care of a daughter, then not a month old, and of John, who was a child of a weakly constitution. He was educated at the free school of Derby, where his father lived. At the age of fourteen, he contracted severe rheumatic trouble, as a result of river-side bathing. The effects of this he felt throughout his life ; he suffered from perpetual ill-health, "my distemper" as he called it. He became so weak that he was scarcely able to go to school and, when not quite sixteen years old, he left school for good. At school his studies had consisted largely of history and Latin. Being lent a copy of Sacrobosco's "Spheres" in Latin he soon began to show an inclination towards mathematics and astronomy, while his father taught him arithmetic. He observed and recorded an eclipse of the sun and learned how to predict eclipses and to calculate the places of the sun. His practical inclinations were shown in the construction of dials and of a quadrant and in grinding lenses for telescopes.

Self-taught by dint of assiduous reading and study, Flamsteed acquired a wide knowledge of astronomy. His observations, made with a small telescope, showed him how deficient were the current astronomical tables. In 1669 he calculated some occulations of stars by the moon for the year 1670, which were transmitted by a friend to Lord Brouncker, the president of the Royal Society. This brought Flamsteed into communication with Oldenburg, the secretary of the Society, and with John Collins, a fellow of the Society, who maintained an extensive correspondence with Newton, Gregory and other prominent fellows.

In 1670 Flamsteed, at his father's suggestion, went to London to become personally acquainted with his learned correspondents. He visited Oldenburg and Collins, who took him to the Tower to meet Sir Jonas Moore, the Surveyor-General of the Ordnance, a mathematician and a fellow of the Royal Society. This was an important event in Flamsteed's life, for Sir Jonas Moore took a great interest in the young astronomer, and became his warm friend and patron : to his help and encouragement Flamsteed owed a great deal. Later in 1670 Flamsteed entered himself at Jesus College, Cambridge and in 1674 he took the M.A. degree. While in Cambridge he made the acquaintance of Dr. Barrow and Mr. Newton.

Flamsteed spent some part of his time in astrological studies, as was not uncommon at that time. But in 1673 he wrote an ephemeris wherein he "showed the falsity of astrology and the ignorance of those who pretended to it". At Sir Jonas Moore's suggestion, he prepared an account of the tides for King Charles II. He also constructed a barometer (a "weather glass" as he called it) and afterwards gave one to Sir Jonas Moore ; he, in turn, presented weather glasses to the King and the Duke of York, giving them also the directions which Flamsteed had prepared for judging the weather from their rise or fall. This, Flamsteed records, brought him "more than ordinary regards from them".

Sir Jonas Moore had shown his interest in Flamsteed in a practical way by offering to pay £10 a year and to obtain a further £10 from two friends, for the employment of an assistant to help him with his observations and computations. On taking his degree, Flamsteed designed to take orders and to settle in a small living near Derby, which was in the gift of a friend of his father. From his early years he had been of a very pious and religious turn of mind. In 1675 he took orders at Ely House, at the hands of Bishop Gunning.

Flamsteed, in the account of his life, says "My desires have always been for learning and divinity ; and although I have been accidentally put from it by God's providence, yet I have always thought myself more qualified for it than for any other employment ; because my bodily weakness will not permit me action and my mind has always been fitted for the contemplation of God and his works".

Plans were at this time under discussion for founding an observatory in London, under the auspices of the Royal Society. Sir Jonas Moore was greatly interested in this project and invited Flamsteed to London to consult him on the subject. He resided at Sir Jonas Moore's house in the Tower, where he carried on his astronomical observations. But while this scheme was under consideration, the event happened which definitely turned Flamsteed's life into a new direction.

At this time there was no satisfactory method of finding the longitude of a ship at sea. The need for a reliable method had become urgent. The proposal had been made that the longitude should be formed by comparing the position of the moon (got by observing her distance from the fixed stars) with her places given by astronomical tables. A Commission, which included Lord Brouncker, the principal officer at the Navy Board, Sir Jonas Moore, and Flamsteed, was set up to report on the plan. The Commission reported (Flamsteed tells us) that this method was indeed the most likely to prove useful to our sailors because most practicable ; but that the catalogue of fixed stars was both erroneous and incomplete ; that the best tables of the moon's motions were inaccurate ; and that these errors would sometimes cause an error of three hundred leagues in the determination of the longitude ; so that our sailors could expect no help from this method till both the places of the fixed stars were rectified, and new tables of the moon's motion made, that might represent her place in the heavens to some tolerable degree of exactness ; for which a large stock of very accurate observations, continued for some years, was altogether requisite, but wanting. That therefore His Majesty would give a great and altogether necessary encouragement to our navigation

* Substance of an address delivered at a tercentenary service held in Burstow Parish Church on Sunday, August 18.

and commerce (the strength and wealth of our nation) if he would cause an observatory to be built, furnished with proper instruments, and persons skilful in mathematics, especially astronomy, to be employed in it, to take new observations of the heavens, both of the fixed stars and planets, in order to correct their places and motions, the moon's especially; that so no help might be wanting to our sailors for correcting their sea charts, or finding the places of their ships at sea.

When the report was shown to the King, he startled at the assertions of the fixed stars' places being false in the catalogue; said, with some vehemence "He must have them anew observed, examined and corrected, for the use of his seamen", and further, when it was urged to him how necessary it was to have a good stock of observations taken for correcting the motions of the moon and planets, with the same earnestness "he must have it done". And when he was asked who could, or who should, do it? "The person (says he) that informs you of them." The outcome was that Charles II decided to found an observatory and Flamsteed was appointed to take charge of it. Chelsea and Hyde Park were considered as possible sites, but in the end, at the suggestion of Sir Christopher Wren, Greenwich was chosen, Charles II giving a site on the highest ground in the Royal Park at Greenwich. Wren was appointed architect of the observatory, which was built at a cost of £520, defrayed by the sale of old and decayed gunpowder. The foundations were laid in August 1675 and the building was completed by July 1676. Flamsteed was appointed, in the terms of the Royal Warrant, "our astronomical observator" (the designation Astronomer Royal was given at a later date: Flamsteed usually signed his name as M.R.—Mathematicus Regius).

He was granted an allowance of £100 a year; from which £10 was deducted as tax. Inadequate as this was, it was often in arrears. Although the Committee had recommended that the observatory should be provided with proper instruments and with skilled persons to observe with them, no instruments were, in fact, ever provided by the Government and the only assistance given was that of a common labourer. Flamsteed's patron, Sir Jonas Moore, generously presented him with a large iron sextant and two clocks by Tompion, the most celebrated maker of clocks of the day. He borrowed also a small quadrant from the Royal Society, but on the death of Sir Jonas Moore, this was called back.

With the sextant it was possible to observe only the relative positions of the stars. An instrument fixed in the meridian was required to determine their absolute positions. Until such an instrument was provided it was not possible for him to achieve the practical ends for which the observatory had been established. Flamsteed made repeated applications to the Government for a mural arc; it was often promised, but it never came. In 1681 he therefore had a mural arc made at his own expense, but it proved to be not sufficiently rigid in construction, and the observations made with it were not of the accuracy that was needed. In 1684 Lord Keeper North presented him with the living of Burstow; soon afterwards his father died and Flamsteed, finding his income somewhat increased, decided to construct a new mural arc, much stronger than the former. This was completed in 1689, at a cost of upwards of £120. The Master of the Ordnance had promised that the cost should be repaid to him; but the promise was not kept and not a farthing of the money he had expended was ever refunded to him.

The tasks that Flamsteed had undertaken were Herculean. They were, first, the construction of a catalogue of the fixed stars, more extensive and more precise than all existing ones; secondly, the systematic observation of the sun, moon and planets with the view to revising the theories of their apparent motions and to constructing tables from which their positions could be computed with the desired accuracy. These tasks were far beyond the capacity of one man, for they involved not merely continuity and regularity of observation over many years, but also extensive computations. It was essential for Flamsteed to have assistance; as none was provided by the Government, he had to defray the cost out of his own pocket. To meet his expenses, it then became necessary for him to take private pupils for instruction in mathematics and astronomy. An additional burden was put upon him by the King who ordered him to instruct two boys monthly from Christ Church Hospital in mathematics. These calls on his time necessarily distracted him from carrying on his astronomical observations with the expedition that he desired. In 1710 Flamsteed stated that he had spent upwards of £2,000 above his salary in furnishing instruments and in hiring assistants and computers.

Under such disheartening conditions and with his persistent ill-health, it was surprising that Flamsteed was able to accomplish so much. His observations were planned with a careful attention to accuracy in their most minute details; he introduced new methods into practical astronomy, many of which are in use to-day; an immense mass of computations were carried out in a systematic and orderly manner, to correct the theories and to improve the tables of the sun, moon and planets, and to elucidate intricate points in practice and theory. He established the fundamental essentials of practical astronomy on sure foundations, which served as a landmark for his successors. In accuracy his observations far exceeded those of his predecessors or contemporaries; they are, in fact, the earliest observations from which the phenomenon of aberration is clearly deducible. In addition he maintained an extensive correspondence with the principal astronomers and scientists of his day.

Flamsteed had realized more clearly than any of his contemporaries that a large stock of accurate observations, continued for many years, was needed to accomplish the tasks on which he was engaged. But it was not long before demands began to be pressed upon him for the publication of his results.

These demands Flamsteed resisted, claiming the right to decide for himself when his results were sufficiently complete and accurate to justify publication. This question of publication was to involve Flamsteed in acute controversies with Newton and Halley, which embittered the later years of his life. For some years Flamsteed and Newton maintained a friendly correspondence and Newton often visited the observatory. Flamsteed had a high regard for Newton; he said that "Mr. Newton's approbation is more to me than the cry of all the ignorant in the world". Newton was occupied at this time with the theory of the motions of the moon; he made frequent requests for Flamsteed's observations and at various times asked him to make observations at certain specified periods. Flamsteed complied with all these requests; he seems, however, to have resented that Newton "was too inconsiderate as to presume he had

a right to that which was only a courtesy" and that "he said not one word of his obligations or debt to the Royal Observatory". The relations between the two men gradually became cooler and eventually widened into an open breach.

At length Flamsteed began to consider the question of publication of his observations and of his great catalogue of stars. He planned to bring out a single great work, which would be a monument to his industry and skill, and would raise the name of England in the astronomical and scientific world. He prepared an estimate of the number of pages; but at this juncture, Prince George, consort of Queen Anne, having learnt of Flamsteed's labours, proposed to have the work printed at his own expense. A body of referees which included Newton, then president of the Royal Society, was appointed to inspect Flamsteed's papers; this was done, and it was recommended that all should be printed. Flamsteed was instructed to hand over a copy of his observations and of his catalogue; but as the catalogue was incomplete and imperfect, he deposited a sealed copy, not for printing but as a guarantee of furnishing a revised and completed copy at a future date. The printing proceeded very slowly and the first volume alone had been completed by 1708, when Prince George died. In 1711 the printing was resumed by order of Queen Anne, but unknown to Flamsteed; a garbled and incorrect edition of the observations with the mural arc and of the imperfect and incomplete catalogue, which had been deposited under seal, was published in 1712 without Flamsteed's consent. It is not surprising that this unauthorized publication was deeply resented by Flamsteed.

A further source of trouble to Flamsteed was the appointment in 1710 of a Board of Visitors of the Observatory with power to demand from Flamsteed each year a true and fair copy of his observations. For Flamsteed, not without reason, looked upon the observations as his own property. It must be remembered that the instruments with which they were made were his own; "the very books in which these observations were entered, the pens and the ink with which they were written, the paper on which they were copied, were all furnished at his own cost, and not at the expense of the public, who contributed nothing but his paltry salary". This question of the proprietorship of the observations made at the Royal Observatory came up in 1762, on the death of Bradley, the third Astronomer Royal. Bradley's executors took possession of his observations and maintained their right to them in a lengthy lawsuit brought by the Crown, even though Bradley was supplied with instruments of the best sort at the public expense and, moreover, had an addition of £250 per annum to his salary. With how much greater right did Flamsteed then regard his observations as his own property!

Flamsteed resolved to publish a correct version of his observations and of his catalogue at his own expense. With this end in view he applied to Newton for the return of the manuscript copy of the catalogue and of 175 sheets of observations. Being unable to secure them, he was compelled to recopy them all for the press at an expense of nearly £200.

Whilst engaged on this work Queen Anne died, there was a change of ministry, and people more friendly to Flamsteed came into power. He was able to secure three hundred out of the four hundred copies of the garbled and incorrect volume that had been printed and he publicly burnt them "as a sacrifice to heavenly truth". He then began printing a revised edition at his own expense, but he did not live to finish the task. In 1719 he died before the printing was nearly completed. It was finished and published in 1725 by the devoted labours of Crosthwait and Sharp, who had been Flamsteed's private assistants.

The "Historia Cœlestis Britannica", in three volumes, containing Flamsteed's observations and his great catalogue of nearly three thousand stars, was the first important contribution to science given by Greenwich Observatory to the world. It opened a new era in sidereal astronomy and stands as an enduring monument to Flamsteed's scrupulous care and unflagging industry and to what he was able to achieve in his forty-four years at the Royal Observatory, in the face of official neglect and very great difficulties. The injustice with which Flamsteed had been treated in his life did not end at his death. The Office of Ordnance attempted to prevent his executors from removing his instruments from the observatory and brought a lawsuit against them; but, as the executors were able to prove that the Office had never paid for any of the instruments, nor even for their repair, the case could not be sustained.

Flamsteed was a man of singular piety; his diaries and letters abound with devout expressions of thankfulness to God. Suffering from continual ill-health, denied the official support which he was entitled to expect, unjustly treated by those who did not appreciate the difficulties with which he had to contend, it is not to be wondered at that in his later years he became embittered. His unwearied perseverance in the face of difficulties and his single-minded devotion to his duties laid the foundations upon which the pre-eminence of the Royal Observatory among the institutions devoted to practical astronomy has been built. He realized better than any of his contemporaries what was most needed in his day for the promotion of astronomy. His work was marked by no brilliant discoveries; but, by unflagging industry and scrupulous care, by systematic observations and insistence upon accuracy, he bequeathed to his successors an immense treasure of observations. His name will always be honoured as that of the first great British observer who established precise astronomy upon secure foundations, and is enrolled among those who have made permanent contributions to the advancement of astronomy.

ANTIBIOTICS IN A POLYPORUS (*POLYSTICTUS SANGUINEUS*)

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Introduction

THE success of the penicillin programme suggested to me a search for antibiotics among the Polypores, the group of higher fungi with the study of which I have been connected for more than a quarter of a century. While Fleming obtained penicillin from *Penicillium notatum* growing in his culture plate as an accidental contaminant from the air, and Dubos and Waksman obtained gramicidin and streptomycin from *Bacillus brevis* and *Actinomyces griseus* respectively, growing in the soil, I have collected this fungus, *Polystictus sanguineus* (L.) Mey., from

decomposed wood, logs and bamboo pieces in various parts of India since 1918. *Polystictus sanguineus* is scarlet-red in colour, it has not been reported so far from Europe ; but it is regarded by many as the analogue in tropical regions of *Trametes cinnabarinus* (Jack.) Fr. which is common in temperate regions of Europe and America.

Systematic description and an account of the geographical distribution of this fungus was published by me in 1918[1], a study of its artificial culture from spore to spore in 1930[2], and cytological study of basidia of sporophore in 1937[3]. A study of the enzymes of *P. sanguineus* in 1937[4] showed that the activity of enzymes in the fruit-body was much less than that in the young vegetative state, and I followed it up in 1939[5] and 1941[6] with a study of the nature of its colouring substances. Unlike *Penicillum* and *Aspergillus*, Polypores generally are very stable, as their genes seem to be in a very well-balanced state and not liable to mutation[7,8].

Since May 1944, I have taken up a study of the antibacterial activity of the culture-filtrate of *Polystictus sanguineus* in various modifications of Czapek-Dox medium (*p*H 7) at room temperature varying from 22° to 32° C. The filtrate has been designated as 'polyporin', and the first report of it was published in August 1944[9]. This was followed later with a short paper on the antibacterial action of polyporin in July 1945[10], and with a note in *Nature*[11] on the antibacterial action of polyporin against typhoid, cholera and dysentery organisms and against *B. coli*.

Culture of the Fungus and Collection of the Antibacterial Substance

The fungus was grown in various modifications of Czapek-Dox medium with addition of manganese sulphate, in some cases with pea-seed extract, with green grass extract and autoclaved wheat-bran extract. It was found that pea-seed-decoction with 4 per cent glucose, manganese ($MnSo_4$) and ferrous sulphate gave a very quick and uniform growth, the fungal mat coming to float on the surface of the medium in the course of three or four days ; the same effect was obtained with Czapek-Dox medium with addition of 1 per cent 'Difco' peptone. The initial *p*H of the different media was 7, but it came down to *p*H 5·8 in the course of about two weeks, the addition of one buffer, either KH_2PO_4 or K_2HPO_4, not having much effect. With double buffers even, *p*H could not be kept stable round about 7. It is very difficult to maintain a uniform standard of growth in all cases. Usually, the antibacterial activity develops in the course of 2–3 weeks, though there is a great variation ; in some cases the antibacterial activity has been noticed in the course of 7–9 days, when there sets in a gradual decline followed again by a rise after a long interval of about 6–8 weeks. We have records of five or six rises and falls of antibacterial titre in the course of about a hundred days. Fresh spores are taken from the fruit-body every now and then, pure cultures from spores for inoculation purposes are maintained in autoclaved solid wheat-bran medium where they grow luxuriantly in the course of about a week ; they are then sub-cultured to nutrient broth for sterility test. If they prove sterile, they are used as seeds for culture-flasks of the Erhlenmeyer or Roux types. Experiments are in progress to maintain a uniform rate of development of the fungus so as to obtain steady production of the antibacterial substance ; we have not, however, always found a necessary correlation between the production of antibacterial titre and the growth-factor of the fungus.

After the fungus has grown in the liquid medium for about two weeks, the culture medium is Seitz-filtered and collected in autoclaved tubes and ampoules. They are then stored at room temperature.

Autoclaving the culture at 120° C. for twenty minutes does not affect its antibacterial power in any way ; the active material is, thus, thermostable, and it was found to be also non-volatile.

Assay of Polyporin in the Laboratory

The crude filtrate has been tested by the agar-cup method against typhoid, cholera, *B. coli*, *Staphylococcus aureus* and *Streptococcus pyogenes*. Very clear inhibition zones of 18–26 mm. are produced. By dilution-method in broth tubes complete lysis in the course of 2–3 days is obtained, as evidenced by the fact that a subculture from the lysed tube shows no growth at all. By disk-method, a strip of the fungal mat in pure culture was set in a nutrient agar plate of typhoid bacillus culture, when a clear lytic zone of 4 mm. was produced round the strip ; similarly, when a circular disk was cut from the fruit-body growing in Nature and placed on a nutrient agar plate of typhoid bacillus culture, a clear lytic zone of 2 mm. was produced round the disk. Distilled water and saline extract of the dried fruit-body in Nature produces a clear lytic zone of 14 mm. against typhoid bacillus and of 12 mm. against *S. aureus* by the agar-cup method.

From these experiments it is concluded that the fungus itself possesses against typhoid bacillus and *S. aureus* lytic properties which become weakened when put in a large mass of liquid medium in artificial culture ; hence, the zones obtained in the plates by the agar-cup method are clear inhibition (not lytic) zones where the bacteria become stationary. By concentration of the crude filtrate, lytic zones of 27–30 mm. could be obtained, while the crude filtrate itself produces only clear inhibition zones of 11–15 mm.

Antibacterial Action

Polyporin is acidic in reaction with *p*H 5·8–6·4, its antibacterial power is not affected by change of *p*H range from 2–8, it is thermostable as already stated, it can be stored at room temperature of the tropics without any loss of potency, and it can be administered orally, as our laboratory experiments show that its potency is not affected in any way by coming in contact with stomach juice, pepsin and hydrochloric acid. Passage through a Seitz filter does not diminish its antibacterial power. Its action is not inhibited by pus, autolysed tissues, serum or blood. On the other hand, it has been noticed with the agar-cup method that in nutrient agar plate-cultures, the zone of inhibition increases as *p*H of the nutrient agar is lowered from 7–6·4 and the zone decreases as the *p*H is increased from 7–7·4.

From a large number of experiments in the course of the last two years, we have obtained sufficient evidence to justify the view that more than one antibiotic material is present in cultures of *Polystictus sanguineus*. Growing in Nature it has to contend for self-existence against diverse groups of pathogenic and non-pathogenic organisms from Protozoa, Bacteria, Actinomyces to other fungi which it happens to come across in its dirty surroundings. A wood-decaying fungus, therefore, is capable of producing

different kinds of antibiotic substances according to the diverse conditions of its growth. Wilkins and Harris[12] have remarked that cultural conditions of fungi in the laboratory, such as composition of the medium, temperature, aeration, etc., determine to a great extent the stimulation or retardation of the production of bacteriostatic substances by them. In his study of the fungistatic powers of *Penicillium notatum*, Overholts[13] holds that penicillin or even notatin is not probably responsible for its antibiotic action against the various fungi of different groups he used in his experiments and that the inhibiting agent may be something entirely different and in no way bound up with the secretion of penicillin.

Toxicity Tests and Animal Experiments

Animal experiments with guinea pigs and rabbits have shown polyporin to be completely non-toxic[9,10]. It is non-hæmolytic and does not produce any pyrogenic effect on intramuscular injection in man. No irritation or any undesirable effect could be detected when the liquid filtrate was applied to the conjunctiva and on superficial open wounds and ulcers in man.

When a vigorous culture of *Vibrio comma* having 1,500 million organisms per c.c. was mixed with 10 c.c. of the crude filtrate (polyporin) having *p*H value of 5·8, and the mixture was injected intraperitoneally into a guinea pig, the guinea pig was saved, while in the control experiment a guinea pig of the same weight, injected similarly with 1,500 millions of *Vibrio comma* alone taken from the same culture, died in the course of twenty-four hours. In another experiment, a twenty-four hours growth of typhoid bacillus (Oxford strain) from nutrient agar was emulsified with autoclaved water and standardized to have 4,000 million organisms per c.c., 0·5 c.c. of this emulsion was mixed with 0·5 c.c. of polyporin (*p*H 7) and incubated for one hour at 37° C.; this mixture (that is, 0·5 c.c. of emulsion and 0·5 c.c. of the filtrate) was then injected intraperitoneally into a guinea pig; the guinea pig survived and remained well; but the control animal of about the same weight injected similarly with 0·5 c.c. of the emulsion only, having 4,000 million organisms per c.c., died in the course of eleven and a half hours. Typhoid bacilli could be recovered in broth culture from the milky peritoneal fluid, heart's blood and congested spleen of the dead guinea pig.

When typhoid vaccine mixed with polyporin was injected subcutaneously into a rabbit, it did not produce any local reaction or uneasiness of the animal, but the control animal similarly injected with typhoid vaccine alone suffered from local swelling and fever. This shows that typhoid vaccine is neutralized by polyporin.

Clinical Trials

In the absence of polyporin of the highest purity, it is not yet possible to state exactly the part polyporin is destined to play in the treatment of infectious diseases. But clinical trials with crude polyporin in our Calcutta hospitals, for the last two years (1944–46), are sufficiently encouraging to justify trials on larger varieties of cases before we try to make a critical comparison of polyporin with other bactericidal agents in the field; it may, however, be claimed that polyporin can be tried in cases where other methods have failed to produce any effective results, as polyporin has not, so far, been found to produce any toxic effect.

Polyporin possesses highly selective action against bacteria. The following is the list of organisms so far tested, which are susceptible to polyporin:

Gram-positive cocci	*Staphylococcus aureus*
	Streptococcus pyogenes
	Streptococcus viridans
Gram-negative bacilli	*B. typhosus*
	B. para typhosus A
	B. para typhosus B
	B. coli
	V. cholerœ
	B. flexner.

Staphylococcus aureus Infections

Staphylococcus aureus infections with or without other associated organisms respond to polyporin very effectively and quickly as observed by clinical trials. The prognosis, however, may be expected to be adversely affected by low vitality of the patient, and by the presence of concurrent diseases.

From the above it can be said that polyporin should be introduced as early as possible and the treatment should be pursued vigorously.

Good results have been obtained in the treatment of local *Staphylococcal* infections not accompanied by septicæmia. Of course, it should be admitted that polyporin cannot replace surgery; hence, wherever there is pus, it should be evacuated without delay before beginning polyporin treatment.

It has been found clinically that certain strains of *Staphylococcus aureus* are not amenable to polyporin treatment, of which we do not know the cause.

Striking results have been obtained with the following varieties of cases by local application of polyporin: (1) abscesses and boils (by aspirating the pus cavity and then replacing the pus by polyporin); (2) carbuncles; (3) bed-sores; (4) eye infections (corneal ulcers caused by *Staphylococcus aureus*); (5) ear, nose and throat infections; (6) different kinds of ulcers—stationary ulcers, indolent ulcers, sulphanilamide-resistant ulcers, etc.; (7) infected lymph glands.

Streptococcal infections. Crude polyporin has been applied locally in *Streptococcus* infected cases with success, though only a small number of cases have been tried.

It has been found that polyporin is effective against infections caused by *Streptococcus pyogenes* and *Strepto. viridans.*

The varieties of cases treated by local application of crude polyporin are puerperal sepsis, ulcers and bed-sores.

Cholera. Clinically we have tried crude polyporin orally in cholera cases in our College Hospital. The results are satisfactory, though saline has not been withheld, because we think that saline is a physiological need and we have to replenish the water-loss by some means. Before we are able to establish its efficacy, we have to treat a larger number of cases and compare them with cases where saline alone is administered. The method of administration of polyporin is one ampoule (containing 3 c.c. of the crude filtrate) orally every four hours.

Typhoid and B. paratyphosus A and B infections. Crude polyporin was clinically tried on patients suffering from typhoid and paratyphosus *A* and *B* infections in our College Hospital and on some private cases of local medical practitioners. Altogether we have treated so far fifty-four cases, among which three deaths have been reported.

From our clinical trials it has been observed that polyporin controls the temperature within a very short time and it lessens the toxicity and prevents complications like tympanites, diarrhœa, etc., which are the terror of typhoid cases. It is also indicated in hæmorrhage cases. It has been further observed that if polyporin treatment is commenced early, that is, on the third or fourth day of the attack, it cuts short the usual period.

Dosage. As already stated, polyporin is neither destroyed nor loses its potency when it comes in contact with gastric juices. Hence it is being administered by oral route. The dosage has been determined arbitrarily; one ampoule (containing 3 c.c. of crude polyporin) is given every four hours. It has been observed clinically that if polyporin is administered in an empty stomach, it gives better results.

Duration of treatment. The duration of treatment will depend upon the severity of the case. It has been observed that it requires seven to ten days for complete recovery. Our usual practice is to continue polyporin for three or four days after the total disappearance of signs and symptoms in order to avoid relapse.

In connexion with typhoid cases it may be mentioned that localized abscesses, such as sub-diaphragmatic abscess caused by typhoid organisms, respond well to crude polyporin by local application.

Chemical Investigation

Chemical investigation of the crude filtrate (polyporin) has been carried out by Prof. N. K. Sen, professor of chemistry, Presidency College, Calcutta. The results of his investigation are appended below.

During the growth of the fungus in the culture medium—a modified Czapek-Dox solution—the original colourless liquid became yellow and finally orange yellow or brown. In some cultures the medium was dark brown in colour and had a somewhat musty odour. There was no smell of ammonia. So, with a view to ascertaining the chemical nature of the antibiotic, the active culture fluid was subjected to the following treatments.

Effect of heat. 200 c.c. of the culture fluid having *p*H 5·8 and giving a zone of 15 mm. against typhoid bacillus was filtered through absorbent cotton and the mycelium squeezed out.

(*a*) 10 c.c. of the filtrate was heated to dryness on a water-bath for six hours. A sticky brown mass was obtained, which was dried in a steam-oven for eight hours. The residue, when tested in aqueous solution, gave an increased activity against typhoid bacillus (19 mm. zone with *p*H 5·4).

(*b*) The remaining sparkling orange-yellow filtrate was distilled under reduced pressure at 60–65° C. The distillate gave *p*H 6·5 with no activity. The brown syrupy residue in the distilling flask had a *p*H 5·5. It was found to be strongly active against typhoid bacillus, producing a lytic zone of 25 mm. by the agar-cup method.

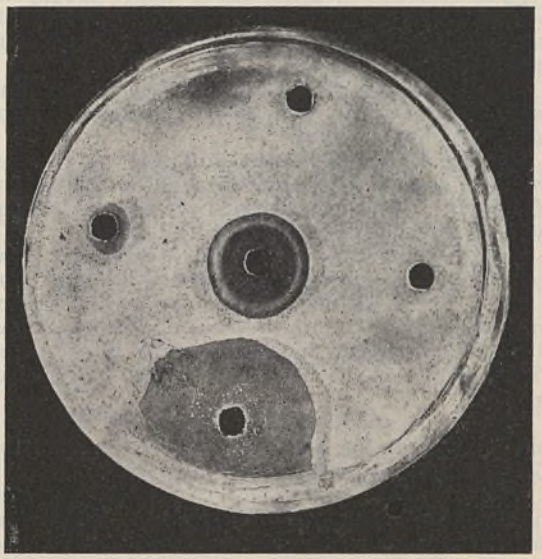
150 c.c. of the distillate was collected, which gave negative tests with Nessler's reagent, Schiff's reagent, Fehling's solution and with alkaline iodine in potassium iodide, showing the absence of free ammonia, reducing substances such as aldehydes and ketones, and alcohols in the distillate.

Effect of heat with steam. (*A*) In alkaline solution. 200 c.c. of the active culture fluid having a *p*H 6·4 with a zone of 14 mm. against typhoid bacillus was made alkaline when the colour of the medium changed to dirty green. The mixture was then subjected to steam distillation and about 150 c.c. of colourless distillate was obtained, which showed the following properties: (1) *p*H, 6·0; (2) no activity against typhoid bacillus; (3) it gave a faint musty smell; (4) the distillate slightly reduced Fehling's solution, ammoniacal silver nitrate and potassium permanganate, indicating the presence of reducing substances in the distillate; (5) it gave a positive iodoform reaction showing the presence of alcohol or bodies containing —CH_3CO— group; (6) Schiff's reagent for aldehydes gave negative result; (7) the presence of amines by carbylamine test could not be shown; (8) with Nessler's reagent a yellow precipitate gradually formed, showing the presence of combined ammonium salts in the original fluid.

(*B*) In acid solution. The alkaline residue after steam distillation was acidified with syrupy phosphoric acid when the colour became reddish-brown and steam distillation was continued. 300 c.c. of the distillate was collected which gave a negative test for phosphoric acid. The distillate and the residue in the flask after neutralization showed no activity against typhoid bacillus. The barium salt obtained from the distillate on neutralization with baryta water was of yellow colour and yielded a mixture of fatty acids on decomposition by sulphuric acid and subsequent extraction with ether.

Concentration

In order to obtain more definite evidence about the chemical nature of the antibiotic substance, 525 c.c. of a light-yellow-coloured culture fluid with *p*H 7·0 and having a slight activity (a 14 mm. zone against typhoid bacillus) was first concentrated by the freezing and thawing method of Challinor and MacNaughtan[14], from which 225 c.c. of an orange-yellow-coloured liquid with *p*H 5·4 was first separated. It gave a greater activity against typhoid bacillus (a 19 mm. zone) than the original fluid. The deep-coloured concentrated solution was purified by chromatography by passing the solution through a column of Brockmann's alumina which adsorbed the red colouring matter. The sparkling yellow filtrate



THE CHOLERA PLATE, AGAR-CUP METHOD. THE ZONE IN THE SIDE REPRESENTS THE 29 MM. LYTIC ZONE OF POLYPORIN IN THE CUP, AND THE 20 MM. ZONE AT THE CENTRE IS OF 0·5 PER CENT MERCURIC CHLORIDE IN THE CUP, USED AS STANDARD IN EVERY PLATE

from the chromatogram practically retained the activity intact (an 18 mm. zone against typhoid bacillus). This was further concentrated under reduced pressure in an atmosphere of an inert gas. The syrupy liquid possessing increasing activity (a 25 mm. zone) was stirred with purified quartz sand and dried over concentrated sulphuric acid in a vacuum desiccator. The dried mass was extracted successively with dry ether, chloroform, ethyl acetate, absolute alcohol and acetone in a Soxhlet apparatus.

A. (1) *Ethereal extract.* The ethereal extract yielded a brown residue which in aqueous solution gave *p*H 5·5 and an increased activity against typhoid bacillus with a lytic zone (31 mm.) by the agar-cup method and gave a negative test for sugar. The aqueous solution of the antibiotic when autoclaved gave a lytic zone of 18 mm. against typhoid bacillus and a lytic zone of 29 mm. against cholera (see accompanying illustration).

(2) *Chloroform extract.* The light-yellow-coloured chloroform extract on evaporation under reduced pressure yielded a syrupy residue which on treatment with water gave a yellow-coloured solution and a brown insoluble sticky mass containing the colouring matter of the original culture fluid. The yellow aqueous solution when put to anti-test gave a lytic zone of 12 mm. against typhoid bacillus.

(3) *Ethyl-acetate extract.* The ethyl-acetate extract yielded a brown syrupy residue on evaporation. The syrup dissolved in water with a reddish-brown colour and gave a clear zone of 20 mm. against typhoid bacillus, 26 mm. against para-typhoid *A*, 21 mm. against para-typhoid *B*, 16 mm. against flexner, and 19 mm. against *B. coli.* It reduced Fehling's solution, showing the presence of reducing sugars.

(4) *Absolute alcohol extract.* The absolute alcohol extract yielded a yellowish-white sticky mass which dissolved in water with a yellow colour and gave a clear zone of 19 mm. against typhoid bacillus. The sticky mass did not solidify when kept over concentrated sulphuric acid in a vacuum desiccator for a long time.

(5) *Acetone extract.* The acetone extract on evaporation under reduced pressure deposited a white waxy mass insoluble in water, possessing no activity against typhoid bacillus.

(6) The residue left after extraction with acetone gave a slight activity when tested in aqueous solution against typhoid bacillus.

B. The sodium salt of the antibiotic was obtained from the original active culture fluid by the method of Berger[15]. The salt retained its activity against typhoid and cholera bacilli for a long time.

From the foregoing experiments it has been found that the active substance is thermostable and non-volatile, but it is destroyed on prolonged heating with steam at 100° C. in presence of alkali and acid. It is acidic in nature and fairly soluble in dry ether. The substance has not yet been obtained in a crystalline form.

Further investigation to isolate the antibiotic in a purer form from the ether extract of the purified and concentrated culture fluid is in progress.

In conclusion, I am grateful to the Indian Health Institute and Laboratories Ltd., of Beliaghata, Calcutta for helping me with two medical assistants, Mr. K. L. De and Mr. P. Ghosal, and one chemical assistant, Mr. Promode R. Banerjee, and for financing this research from the very beginning. I regret that more in the way of facilities has not been available for the quick and satisfactory progress of this work.

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THE VELOCITY OF SOUND: A MOLECULAR PROPERTY

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THE classical conception of the mechanism of the propagation of sound in gases presents two alternative expressions for the velocity, according as one assumes with Newton that the elastic processes are isothermal, or with Laplace that they are adiabatic. It is well known that experiments show the latter to be appropriate down to the lowest frequencies at which measurements have been made. The ratio of specific heats at constant pressure and constant volume respectively is characteristic of the molecules of a gas, and for this reason was much sought by Kundt and later experimenters on the velocity of sound in gases contained in tubes. Since the advent of convenient sources of high-frequency sound waves (supersonics) in the past twenty years, results have come to light which show that the ratio of specific heats may not be constant at all frequencies of vibration. Thus, Pierce[1] in 1925 found that the velocity of sound in carbon dioxide rose at a frequency in the neighbourhood of 100 kc./sec. by about 5 per cent. The effect has since been confirmed for other—mostly triatomic—gases, little change being noted in diatomic gases at ordinary temperatures up to the upper limit of frequency (about 5 megacycles per second) as yet attained.

An explanation of these results was put forward in its essential form by Herzfeld and Rice[2] in 1928 in what is known as the 'relaxation theory', although this theory goes commonly under the name of Kneser. In this theory it is supposed that the energy passed on through a system of molecules begins as translational, so that each one gets a pull or push in the direction of propagation of the waves, but that the molecules begin to convert this external energy of translation into internal vibrations (or rotations), like a train of railway wagons impelled by a locomotive, before passing it on. At low frequencies, the compressions follow each other more slowly than these 'relaxations' can take place; but when they succeed each other more rapidly than the molecules can convert the energy into internal energy, the molecules pass it on with less delay, so that the speed with which the sound wave passes through the system increases. The form of the variation of velocity with frequency envisaged by this theory—two level lines

connected by a short upcast at the critical frequency —is exactly like that predicted by Debye's relaxation theory for dielectric constants at high frequency. At the same time, this relaxation upsets the phase relationship between particle velocity and pressure in the sound wave, and this in turn is apparent as an enhanced absorption of the sound.

Besides the limited number of pure gases in which this effect has been noted, quite a number of gases which otherwise behave normally show changes of velocity with frequency if they are mixed with a small quantity of a 'catalyst'; such, for example, is oxygen mixed with a small quantity of water vapour.

If we increase or reduce the pressure on a gas, we increase or reduce the frequency of collisions on which the conversion from translational to vibrational energy depends, and so push the dispersion region higher up the scale of frequency. Increase of temperature can also do this, but any relaxation effect that ensues has to be carefully sorted out from the ordinary rise of velocity of sound with temperature due to the reduction in density of the gas.

It should be noted that the hypothesis here outlined is a purely *a posteriori* one. The mean time of relaxation of a molecule on this hypothesis can be calculated if the frequency at which the change-over from low-frequency velocity to high-frequency velocity is measured experimentally, but there is no independent experimental approach to the problem as yet—and in only one case has the relaxation time been calculated *a priori*. The problem of calculating the time of relaxation for simple molecules considered as harmonic oscillators is to find the number of collisions necessary, on the average, to produce an augmentation of the vibrational or rotational energies at the expense of the translational. As this augmentation can only take place by discontinuous jumps and requires more energy of translation than the molecules may possess individually, each collision is not effective; but one can calculate the percentage of molecules having the requisite velocity bearing in mind the type of collision—end-on, broadside, etc.—required to produce a vibration or rotation as the case may be. Van Paemel and Mariens[3] have thus found for the latter transformation mean times of 2×10^{-6} sec. for oxygen and $1{\cdot}3 \times 10^{-9}$ and $6{\cdot}6 \times 10^{-10}$ sec. for hydrogen and deuterium respectively at N.T.P. Although one experimental result corroborates the former value, most workers have failed to record any dispersion of the velocity of sound in oxygen, while the other two frequencies lie too high at present for certain experimental confirmation.

The possibility of influencing the molecules to react specifically to high-frequency sound by the addition of catalysts has already been mentioned. Other experimenters have tried to 'excite' the molecule by physical means. Dwyer[4] applied an electric shock to the iodine molecule by passing a discharge through the vapour; Van Itterbeek and Thys[5], a magnetic field to oxygen and nitric oxide; while I myself sought[6] for a change in the acoustic dispersion of carbon dioxide when irradiated with infra-red rays at one of its natural (optical) frequencies. None of these means of excitation can as yet be claimed to have effected its object, although the Belgian workers say that the *absorption* of sound waves in oxygen is increased in the presence of the magnetic field. (They found no change of velocity.) If some such effect were established it could be claimed as an indirect confirmation of the relaxation theory.

Turning to liquids, there is no evidence for dispersion of velocity—other than the steady fall with frequency which can be ascribed to the effect of friction at high frequencies. There is, nevertheless, strong absorption and some evidence for *scattering* of the sound waves out of the direct beam. (It will be appreciated that, with high-frequency sound waves, it is impossible to get a forthright beam in the sense that one does commonly in light, because the radiating face from which the sound streams cannot, in laboratory experiments in any event, be made very large compared to the wave-length. The scattering referred to is deviation in excess of that predicted by classical diffraction theory.) Such scattering has been ascribed either to the quasi-crystalline structure of a liquid, as postulated by Debye and others, or to the interaction between the sound and the thermal waves of casual origin which throng a liquid medium and give rise to a rapidly changing pattern of density fluctuations which then act as scattering centres. Attempts by Yvon[7] and others to relate the scattering to these thermal waves have so far led to little result of use owing to the indeterminacy of the wave-length of the thermal 'modulations' of the sound waves. It is noteworthy that liquids in which this acoustical anisotropy is most marked are just those, like benzene and xylene, in which the effects of optical anisotropy are commonly demonstrated.

A generalization, which is at present unsubstantiated by theory, was pointed out by M. R. Rao[8] between the velocities of sound (v) in liquid members of homologous series and the molecular weight (M) and density (d). He found in fact that $v^{1/3}\,M/d$ was a constant throughout such a series. Lagemann and Dunbar[9] have tested this parameter, which they call the 'molecular velocity of sound'—though mark that it has not the dimensions of a velocity—against other physical properties of the members of the series such as viscosity, surface tension, Van der Waals' constant, etc., and found linear relationships between it and other parameters involving these quantities. One feels, however, that such relationships in the absence of theoretical backing are too facile to set up.

Finally, what is the effect in vapours, especially near the critical point? No marked change of velocity with frequency has been reported, but some recently discovered peculiar effects in liquid helium require further discussion. Groenewald[10] pointed out in 1939 that owing to the high thermal conductivity of helium II, it might be expected to propagate sound under isothermal rather than adiabatic conditions. However, as the ratio of specific heats in helium is nearly unity, this would probably escape experimental observation. But there is another consequence of the high conductivity, for whereas in ordinary fluid, waves of temperature, if set up, are propagated at a very low velocity and are highly damped, in this peculiar medium they compare in velocity and persistence with the compressional waves. (To a first approximation, the speed of thermal waves of frequency f in a medium of thermal diffusivity k is $(4\pi kf)^{1/2}$ and the damping coefficient $(\pi f/k)^{1/2}$.) Such thermal waves might be set up in the compressions sent out by a conventional sound source, but they can best be studied by using an *ad hoc* source such as a metal plate in which an oscillatory temperature change is set up.

Such a source is a platinum strip to which alternating current is fed and is known in Great Britain as a 'thermophone', the invention of an engineer

named De Lange. In an ordinary fluid it sends out both thermal waves and sound (compressional) waves in virtue of the expansions and contractions of the fluid in its vicinity, but the former vanish in a few millimetres, leaving the sound waves which are radiated into the fluid in the normal way. (The frequency of these is double that of the alternating current supply.) In a fluid of great conductivity, the thermal waves should be appreciable to a much greater distance, and the true sound waves might be of less significance as local expansions and contractions of the fluid would be more difficult to set up; moreover, the latter would be of isothermal type. Peshkov[11] has made experiments with such a source in liquid helium near the λ-point using a resistance thermometer to plot out the thermal waves. His results indicate for the liquid a thermal diffusivity of order 10^3. He himself, following Landau[12], who in other respects is in agreement with Groenewald's ideas, ascribes this radiation to a special type of sound propagation called "the second velocity of sound in He II", associated with its abnormal fluidity; but it appears to me that no special property of the fluid is necessary to explain Peshkov's results other than that of superconductivity.

It is hoped that this résumé of recent work suffices to indicate the new avenues of approach to molecular physics which are opened up by measurements of the velocity of sound. Measurements of absorption, too, are of value, but their usefulness is limited by the need to sort out the absorption from the effects of diffraction.

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THE UNITED NATIONS EDUCATIONAL, SCIENTIFIC AND CULTURAL ORGANISATION

THE progress report on the programme of the United Nations Educational, Scientific and Cultural Organisation, submitted to the Preparatory Commission at its fifth session opening on July 5, embodies the preliminary recommendations of the Secretariat and includes summaries of reports from the seven sectional committees. It is emphasized that U.N.E.S.C.O. will be principally concerned with the international aspects and implications of such questions and problems as lie within its domain, and that wherever possible it will work in collaboration with existing international organisations but will develop an active programme to supplement the work of other organisations. One of its prime tasks will be to promote the sciences and arts for their own sake, and their applications for the sake of human welfare. As regards science and knowledge, this will best be done by increasing and unifying the total volume of work, and in particular by bringing activity in the less-advanced areas towards the level of the more advanced. Another main aim is the encouragement of education and the free flow of information across national frontiers. In all fields freedom of research, information, opinion and education should be encouraged, and the approach must be world-wide.

In a general outline and synthesis of the proposed projects and activities of the Organisation, it is suggested that in addition to establishing effective working relations with other agencies of the United Nations and such bodies as the International Council of Scientific Unions, International Broadcasting Union, the Confederation of Authors' and Composers' Societies, it is suggested that U.N.E.S.C.O. should initiate the establishment of new international agencies such, for example, as an Association for Adult Education, a Microfilm Documentation Organisation, a Publications Clearing House, to supplement or continue the work of the Inter-Allied Book Centre and the American Book Centre, a Union of Engineering Associations and Federation of Film Archives. The establishment of regional offices throughout the world is also proposed, such offices to be housed in the same buildings as other United Nations organisations and agencies. Within its structure U.N.E.S.C.O. should maintain a library, archives and information service, with special collections of publications, films, recordings and other material to serve its various programmes. The library and information service should also assist in the preparation and distribution of bibliographies, abstracts, reading lists and reports, as well as promote the distribution and exchange of all U.N.E.S.C.O. publications. In addition, the report suggests the establishment of a world library centre, a world museography library and a scientific apparatus information bureau for the standardization of scientific equipment and the collection and dissemination of information and technical data relating to such equipment.

Studies and surveys which it is considered the Secretariat of the Organisation could well undertake itself with the aid of experts invited for the purpose include an inventory of the world's resources for research and study at the level of higher education, as suggested by the Natural Sciences and the Social Sciences Committee. The Natural Sciences Committee also proposes a study of the rationalization of the present system of publication of scientific journals, including abstracting and reviewing services, while the Social Sciences Committee proposes studies of the effects of mechanization upon civilization and of methods of facilitating international understanding and a report on public opinion surveys. Methods of operating, financing and staffing national library services are suggested for survey by the Libraries and Museums Committee, while the Education Committee advocates study of proposals for a world university and analyses of text-books, especially in history, geography and civics, to improve their international character. It is also suggested by the Social Sciences Committee that U.N.E.S.C.O. should set up under its auspices special institutes or commissions to survey home and community planning and to report on the use and misuse of modern psychology as a political technique. The Media of Mass Communication Committee would handle studies on mass communication in a like manner, while it is also suggested that U.N.E.S.C.O. should encourage or invite other international organisations or agencies to co-operate in examining the standardization of

scientific terms and equipment, library classification, bibliographic technique and publication sizes and format, as well as studies on nationalization and internationalism and population and racial problems.

In addition to this the various committees propose that U.N.E.S.C.O. should promote, encourage or undertake certain publications. The Education Committee suggests an International Education Journal and an International Education Yearbook, the Natural Sciences Committee suggests abstracting and reviewing journals in fields not adequately covered at present, summaries of scientific data, tables and handbooks, and popular publications on the international implications of science; and the Social Sciences Committee, a handbook of Social Science Research Organisations; a Yearbook of the Social Sciences, a Monthly Bulletin of the Social Sciences, which should include selected abstracts and bibliographies and popular publications on topics of world interest. Publications proposed by the Libraries and Museums Committee include a Directory of Science and Learning, covering all fields, and including information on available apparatus and facilities as well as personnel, other world reference books, such as Europa and Minerva, multi-lingual dictionaries and lexica of scientific and technical terms, an Annual Directory of Museums and Galleries, an International Museums Journal and Abstracts. It is also proposed by the Social Sciences Committee that U.N.E.S.C.O. should create a Study Centre in International Relations to be attended by graduates selected from all countries.

In addition to encouraging and furthering the national exchange of publications, films, scientific equipment and apparatus, etc., it is proposed that U.N.E.S.C.O. should, at the earliest possible date, summon international conferences on copyright and on International Relations in Institutes of Higher Learning. It is assumed that the former Conference will recommend an international agreement on copyright, while it is proposed that international agreements on the exchange of educational and documentary films and on postal and telecommunication rates will be recommended as early as possible. Institution of a system of grants-in-aid for both institutions and individuals, including research and sample and pilot projects, are among the numerous other activities proposed for U.N.E.S.C.O., while among the concrete pilot projects which U.N.E.S.C.O. could undertake to demonstrate its character and to open up unexplored fields the Natural Sciences Committee suggests outlines of text-books for a course in general science suitable for general cultival education, a U.N.E.S.C.O. Astronomical Observatory and a Meteorological Station in the Southern Hemisphere, a Centre of Applied Mathematics, for example, in India or China, a Nutritional Laboratory and an Institute for the study of problems in the equatorial forest belt. Special attention to the interchange of students, teachers and other professional workers is recommended by the Education Committee, while the Natural Sciences Committee regards the speeding up of the work of scientific rehabilitation as the most urgent problem of the moment. This Committee's report stresses the need to support and extend the work of the International Scientific Unions and in regard to the movement of men of science suggests the issue of some kind of identity card, recognized by all nations, as certifying the holder to be an accredited man of science, travelling on genuine scientific business.

NEWS and VIEWS

Geology at Glasgow: Prof. A. E. Trueman, F.R.S.

Prof. A. E. Trueman, professor of geology in the University of Glasgow, whose appointment as deputy chairman of the University Grants Committee has recently been announced, is a graduate of University College, Nottingham. He has been successively professor of geology at University College, Swansea (1920–33), the University of Bristol (1933–37), and the University of Glasgow (1937–46). His earlier researches on the evolution and variation of many fossil invertebrates from the Liassic rocks formed a good preparation for his most important work, which deals with the non-marine Lamellibranchs and zonal stratigraphy of the Coal Measures. The variation of these fossil shells was studied with a keen eye to detail and a philosophic insight which has led to the establishment of a fluid but precise nomenclature. In the hands of Prof. Trueman and his co-workers the non-marine Lamellibranchs have become of extreme economic importance in the correlation of seams in British and Continental coalfields. This work has been particularly valuable during the War, when Prof. Trueman's specialized knowledge was ever at the service of the Geological Survey. In collaboration with Dr. J. Weir he is writing a monograph on these shells, now in course of publication by the Palæontographical Society.

Apart from these research activities, Prof. Trueman has much experience of administrative work, and has taken a prominent part in the spreading of scientific knowledge and in the field of higher education. He has been a member of the Geological Survey Board for a number of years, and recently succeeded Sir Franklin Sibly as chairman. As secretary of the British Association Committee on the Teaching of Geology in Schools he has attempted to introduce geology to a wider audience, a purpose also served by his two books "The Scenery of England and Wales" and "An Introduction to Geology". As a member of the Elliot Commission (1943–4) he took an active interest in the problems of higher education in West Africa, and he has been a popular and successful president of the Geological Society since 1945. Prof. Trueman was awarded the Gold Medal of the South Wales Institute of Engineers in 1934, and the Bigsby Medal of the Geological Society in 1939.

Prof. Thomas N. George

Prof. Thomas N. George has been appointed to succeed Prof. A. E. Trueman for a second time. After graduating in the University of Wales and at Cambridge, and then working for three years on the Geological Survey of Great Britain, Dr. George in 1933 succeeded Trueman as professor of geology and head of the Departments of Geology and Geography

at University College, Swansea. Much of his work relates to the carboniferous limestone of South Wales, where he has mapped extensive areas and revealed structural information of great interest in relation to the folding of the limestones. In connexion with these studies he has investigated carboniferous fossils, and especially the brachiopods and goniatites. He has made considerable contributions to the geomorphology of Wales, and his studies of river development have been of great interest. Work on glacial deposits, on raised-beach and cave deposits, and on more general geological problems indicates the wide range of his interests. Prof. George has also been active in university administration and in various branches of adult educational work.

Chemistry at Birmingham

A SECOND chair has been established in the Department of Chemistry in the University of Birmingham and Dr. Maurice Stacey, at present reader in biological chemistry, has been appointed to it. Dr. Stacey graduated at Birmingham in 1929 and engaged in carbohydrate research work under Prof. W. N. Haworth. He obtained his Ph.D. degree in 1932 and in the following year was awarded the Meldola Medal mainly for his work with Haworth and Hirst on the synthesis of vitamin C. In the same year he gained a Beit Memorial fellowship for medical research, which he held at the London School of Hygiene and Tropical Medicine under Prof. H. Raistrick. Here he worked on the structure of complex carbohydrates produced by moulds and on the immunochemistry of bacteria in the typhoid group. In 1936 he rejoined Prof. W. N. Haworth's staff at Birmingham as lecturer and in 1937 spent some time with Prof. M. Heidelberger at Columbia University Medical School, New York. He was awarded his D.Sc. in 1939. For some years Dr. Stacey has directed a team of research workers engaged in studying the chemistry of micro-organisms and recently has made important advances in this field. Since 1940 he has been leader of Prof. W. N. Haworth's large group engaged in problems connected with the chemical side of the atomic energy project. Dr. Stacey was a member of the Tube Alloys Chemical and other Panels and is a member of council of the Chemical Society and a fellow of the Royal Institute of Chemistry.

Dr. Fred Smith, who is returning to the department in October after spending two and a half years on the atomic energy project and at the University of Minnesota, has been promoted to a senior lectureship in the University. Dr. E. J. Bourne has been appointed to a lectureship. Dr. M. Webb has been appointed to an Imperial Chemical Industries fellowship. Dr. F. H. Newth and Mr. P. W. Kent have been appointed assistant lecturers. Mr. J. Read and Dr. G. A. Gilbert, Imperial Chemical Industries fellows, are shortly going to the United States to engage in research work.

European Archæology at Oxford : C. F. C. Hawkes

MR. CHRISTOPHER F. C. HAWKES, the first holder of the new chair of European archæology at Oxford, is one of the most active among the younger prehistorians. He was a scholar of Winchester and of New College, and entered the British Museum shortly after taking his degree in the Honour School of Literæ Humaniores. While still an undergraduate, he took part in the excavation of the entrenched camp on St. Catharine's Hill, and later conducted a series of excavations at Colchester (Roman *Camulodunum*), the results of which have been published recently. In 1932 he was a secretary of the International Congress of Prehistoric and Protohistoric Sciences in London, and published with W. T. D. Kendrick a retrospect of "Archæology in England and Wales, 1914–1931". Mr. Hawkes is a fellow of the Society of Antiquaries and an active member of the Royal Anthropological Institute and the Archæological Institute. His principal publication is "The Prehistoric Foundations of Europe" (Methuen, 1940). In his excavations and other field work, Mr. Hawkes has shown himself an inspiring leader and teacher, and at Oxford he will have every encouragement to build up a strong school of prehistoric archæology.

Presentation to Prof. E. K. Rideal, F.R.S.

IT was announced in *Nature* for December 25, 1945, that Prof. E. K. Rideal, professor of colloid science in the University of Cambridge, had been appointed Fullerian Professor at the Royal Institution and director of the Davy Faraday Laboratory as from next October. Recently the Department of Colloid Science issued invitations to all its members past and present, and to all those who had been associated with Prof. Rideal as collaborators in research, to a presentation dinner. This took place in Trinity Hall, Cambridge, on July 6, and nearly ninety people attended from all over the British Isles as well as a few from overseas. To mark this occasion a bibliography was prepared of all the original scientific works achieved under Prof. Rideal's direction or in association with him over a period of some thirty-five years. A copy was presented to Prof. Rideal and to all subscribing members. The book has some five hundred and fifty references of original work, and emphasizes Prof. Rideal's great activity in building up the School of Colloid Science in the University of Cambridge. We feel sure that the cordial good wishes of many who were unable to attend this function will go with Prof. Rideal in his new appointment.

Commemoration of Alexander Samoilov

A CONFERENCE dedicated to the memory of the eminent physiologist Prof. Alexander Samoilov took place recently in the University of Moscow on the occasion of the fifteenth anniversary of his death in 1930. Prof. Samoilov, who was responsible for important advances in the physiology of the nervous system and in electrocardiography, was well known outside his country—in the United States, Great Britain and Holland, where he delivered speeches and lectures many times. Papers sent by E. D. Adrian (Cambridge), John F. Fulton (Yale) and Paul D. White (Boston, Mass.) were read at the conference. Speeches were also delivered by Ch. S. Koschtojanz, director of the Samoilov Laboratory of the University of Moscow and professor of physiology, and by Prof. V. Parin. The Institute of History of Natural Sciences of the Academy of Sciences of the U.S.S.R. organised in connexion with the conference an interesting exhibition of photographs portraying the life and works of Samoilov and his friendly and scientific relations with many celebrated physiologists of Europe and America. The Institute presented to each participant at the conference a reprint of the bibliography of the works of Prof. Samoilov.

RECENT SCIENTIFIC and TECHNICAL BOOKS

Volumes marked with an asterisk (*) have been received at "NATURE" Office

Mathematics : Mechanics : Physics

BELL, A. H. A Practical Course of Mathematics. Cr. 8vo. Pp. 438. (London, Glasgow and Bombay : Blackie and Son, Ltd., 1946.) 7*s.* 6*d.*

BILL, E. T. Development of Mathematics. Revised edition. Demy 8vo. Pp. 638. (New York and London : McGraw-Hill Book Co., Inc., 1946.) 30*s.*

BOUTRY, G.-A. Optique instrumentale. Imp. 8vo. Pp. x +540. (Paris : Masson et Cie., 1946.)*

DONTOT, R. Etude élémentaire de la Parataxie et des Cyclides. Cr. 8vo. Pp. 200. (Paris : Libr. Vuibert, 1945.) 135 francs.

GODFREY, C., and SIDDONS, A. W. The Teaching of Elementary Mathematics. Second edition. Cr. 8vo. Pp. xii + 322. (Cambridge : At the University Press, 1946.) 7*s.* 6*d.* net.

HUMBY, S. R. Electricity and Magnetism for Students. Second edition. Cr. 8vo. Pp. 336. (London : John Murray, 1945.) 6*s.* 6*d.**

MURSI, ZAKI. Tables of Legendre Associated Functions. (Fouad I University, Faculty of Science, No. 4.) Med. 4to. Pp. viii +286. (Cairo : E. and R. Schindler, 1941.)*

HOUSEHOLDER, ALSTON S., and LANDAHL, HERBERT D. Mathematical Biophysics of the Central Nervous System. (Mathematical Biophysics Monographs Series, No. 1.) Roy. 8vo. Pp. ix + 124. (Bloomington, Ind. : Principia Press, 1945.)*

STONE, W. J. Building Geometry. (Building Craft Series.) Cr. 8vo. Pp. 213. (London, New York and Toronto : Longmans, Green and Co., Ltd., 1946.) 7*s.* 6*d.*

TURNER, N. C., Compiled by. Atomic Energy for Peace and War : the 'How' and 'Why' of Atomic Energy. Cr. 8vo. Pp. 35. (Edinburgh and London : Oliver and Boyd, 1946.) 1*s.* net.*

Engineering

FREEMAN, WILLIAM. Water Supply and Drainage. (Engineering in Everyday Life Series.) Cr. 8vo. Pp. 40. (London : Sir Isaac Pitman and Sons, Ltd., 1946.) 1*s.* 6*d.* net.

HIGGINS, ALEXANDER. Boiler Room Questions and Answers. 4to. Pp. 140. (New York and London : McGraw-Hill Book Co., Inc., 1946.) 18*s.*

JUDGE, ARTHUR W. Modern Petrol Engines : with Special Reference to Automobile, Aircraft and Stationary Types. Demy 8vo. Pp. viii +509. (London : Chapman and Hall, Ltd., 1946.) 36*s.* net.*

LABBERTON, J. M., and MARKS, L. S., Edited by. Marine Engineering Handbook. Cr. 8vo. Pp. 2014. (New York and London : McGraw-Hill Book Co., Inc., 1946.) 45*s.*

LEWIS, GEORGE. Radio Constructor's Manual, No. 1. Cr. 8vo. Pp. 60. (London : Bernards (Publishers), Ltd., 1946.) 3*s.* net.

PERROTT, S. WRIGHT. Surveying for Young Engineers. Cr. 8vo. Pp. viii +232. (London : Chapman and Hall, Ltd., 1946.) 10*s.* 6*d.* net.*

'RADIOTRICIAN.' Radio Tuner Unit Manual. Cr. 8vo. Pp. 48. (London : Bernards (Publishers), Ltd., 1946.) 2*s.* 6*d.* net.

TREACY, JOHN. Production Illustration : Techniques and Applications of Perspective Engineering Drawings. Med. 4to. Pp. ix + 202. (New York : John Wiley and Sons, Inc. ; London : Chapman and Hall, Ltd., 1946.) 24*s.* net.

DE WEESE, F. C. Transmission Lines. Demy 8vo. Pp. 218. (New York and London : McGraw-Hill Book Co., Inc., 1946.) 21*s.*

YOUNG, H. P. Electric Power System Control. (Monographs on Electrical Engineering, Vol. 11.) Second edition, revised and enlarged. Demy 8vo. Pp. xii +369. (London : Chapman and Hall, Ltd., 1946.) 25*s.* net.*

Chemistry : Chemical Industry

COX, H. E. The Chemical Analysis of Foods. Third edition. Demy 8vo. Pp. 326. (London : J. and A. Churchill, Ltd., 1946.) 24*s.*

LOWY, ALEXANDER, HARROW, BENJAMIN, and APFELBAUM, PERCY M. Introduction to Organic Chemistry. Sixth edition. Demy 8vo. Pp. xiv + 448. (New York : John Wiley and Sons, Inc. ; London : Chapman and Hall, Ltd., 1946.) 21*s.* net.

SHEARCROFT, W. F. F. Photographic Chemicals. New edition. Cr. 8vo. Pp. 82. (London : Fountain Press, Ltd., 1946.) 5*s.* net.

TWISS, S. B., Edited by. Advancing Fronts in Chemistry. Vol. 1 : High Polymers. Demy 8vo. Pp. 196. (New York : Reinhold Publishing Corporation ; London : Chapman and Hall, Ltd., 1946.) 24*s.* net.

Technology

BRITISH JOURNAL Photographic Almanac and Photographer's Daily Companion, 1946. Edited by Arthur J. Dalladay. Cr. 8vo. Pp. 412 + 31 plates. (London : Henry Greenwood and Co., Ltd., 1946.) 3*s.* 6*d.* net.*

ECKMAN, DONALD P. Principles of Industrial Process Control. Demy 8vo. Pp. x +238. (New York : John Wiley and Sons, Inc. ; London : Chapman and Hall, Ltd., 1946.) 21*s.* net.

LEWIS, WINIFRED. Thin Films and Surfaces : Structure and Properties, Production of Thin Films, Detailed Properties of Aluminium with Comparative Data for other Metals, Applications. Demy 8vo. Pp. vi + 70 + 2 plates. (London : Temple Press, Ltd., 1946.) 15*s.* net.*

SMITH, J. CAMPBELL. The Chemistry and Metallurgy of Dental Materials. Med. 8vo. Pp. v +317. (Oxford : B. H. Blackwell, Ltd., 1946.) 21*s.* net.

TOWNSEND, G. Carpentry. Demy 8vo. Pp. 442. (Kingston Hill : Technical Press, Ltd., 1946.) 14*s.* net.

TUCKER, W. J., and ROBERTS, R. S. Plastics for Electrical and Radio Engineers. Demy 8vo. Pp. x +148. (Kingston Hill : Technical Press, Ltd., 1946.) 12*s.* net.

Geology : Mineralogy

COTTON, C. A. Earth Beneath : an Introduction to Geology for Readers in New Zealand. Demy 8vo. Pp. 128. (Melbourne, Auckland and London : Whitcombe and Tombs, Ltd., 1946.) 9*s.*

DREYFUSS, M. Guide pratique du géologue du Terrain. 8vo. Pp. 272. (Montpellier : Dubois et Poulain, 1946.) 370 francs.

ZEUNER, FREDERICK E. Dating the Past : an Introduction to Geochronology. Demy 8vo. Pp. xviii +444 + 24 plates. (London : Methuen and Co., Ltd., 1946.) 30*s.* net.*

Geography : Travel

BAILY, LESLIE, Edited by. Travellers' Tales : a Series of B.B.C. Programmes Broadcast Throughout the World. Demy 8vo. Pp. 307. (London : George Allen and Unwin, Ltd., 1946.) 16*s.* net.

BASKINE, GERTRUDE. Hitch-hiking the Alaska Highway. Demy 8vo. Pp. x + 317. (Toronto : The Macmillan Company of Canada, Ltd., 1944.) 12*s.* 6*d.* net.

CHHIBBER, H. L. India. Part 1 : Physical Basis of Geography of India. Demy 8vo. Pp. xix + 282 + 10 plates. (Benares : Nand Kishore and Bros., 1945.) 5 rupees.*

DOWNES, P. G. Sleeping Island : the Story of One Man's Travels in the Great Barren Lands of the Canadian North. Demy 8vo. Pp. 191. (London : Herbert Jenkins, Ltd., 1946.) 15*s.* net.

DURRELL, LAWRENCE. Prospero's Cell: a Guide to the Landscape and Manners of the Island of Corcyra. Demy 8vo. Pp. 142. (London: Faber and Faber, Ltd., 1946.) 10*s.* 6*d.* net.

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BRUES, CHARLES T. Insect Dietary: an Account of the Food Habits of Insects. Demy 8vo. Pp. xxvi +466 + 22 plates. (Cambridge, Mass.: Harvard University Press; London: Oxford University Press, 1946.) 28*s.* net.*

HAIG-BROWN, RODERICK. Silver: the Life Story of an Atlantic Salmon. Second edition. Cr. 8vo. Pp. 95. (London: Adam and Charles Black, Ltd., 1946.) 5*s.* net.

LEA, D. E. Actions of Radiations on Living Cells. Demy 8vo. Pp. xii + 402 + 4 plates. (Cambridge: At the University Press, 1946.) 21*s.* net.*

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PEATTIE, DONALD CULROSS. The Road of a Naturalist. Demy 8vo. Pp. 220. (London: Robert Hale, Ltd., 1946.) 12*s.* 6*d.* net.

STAPLES, C. PERCIVAL. Birds in a Garden Sanctuary. Demy 8vo. Pp. 192 +31 plates. (London and New York: Frederick Warne and Co., Ltd., 1946.) 12*s.* 6*d.* net.

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BAKER, J. O. Market Gardening as a Career. Cr. 8vo. Pp. 64. (Loughton: Vawser and Wiles, Ltd., 1946.) 5*s.* net.

BATESON, F. W., Edited by. Towards a Socialist Agriculture: Studies by a Group of Fabians. Cr. 8vo. Pp. xii +186. (London: Victor Gollancz, Ltd., 1946). 6*s.* net.*

COCHRANE, E. R. The Milch Cow in England: a Plea for Constructive Breeding. Demy 8vo. Pp. 348 +16 plates. (London: Faber and Faber, Ltd., 1946.) 16*s.* net.*

FISHWICK, V. C. Pigs: their Breeding, Feeding and Management. Revised edition. Demy 8vo. Pp. xi +222. (London: Crosby Lockwood and Son, Ltd., 1946.) 12*s.* 6*d.* net.

GOOD HEALTH to the Garden: How to Combat the Pests, Diseases and Weeds of Vegetables. Demy 8vo. Pp. 48. (Yalding: Plant Protection, Ltd., 1946.) 3*s.* 6*d* net.*

HURT, E. F. Sunflower for Food, Fodder and Fertility: its Economic Value, World Expansion and Cultivation, with particular reference to Great Britain. Demy 8vo. Pp. 155 + 20 plates. (London: Faber and Faber, Ltd., 1946.) 10*s.* 6*d.* net.*

KELLEY, R. B. Principles and Methods of Animal Breeding. Demy 8vo. Pp. 296. (Melbourne, Auckland and London: Angus and Robertson, Ltd., 1946.) 15*s.* net.

MANSFIELD, T. C. Shrubs in Colour and Cultivation. (Garden in Colour Series.) Demy 8vo. Pp. 264 +80 plates. (London and Glasgow: Wm. Collins, Sons and Co., Ltd., 1946.) 21*s.* net.

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BOGOMOLETZ, O. A. The Influence of the Antireticular Cytotoxic Serum (ACS) upon the Healing of Bone Fractures. (In Russian, with English Summary.) Demy 8vo. Pp. 196. (Kiev: Academy of Sciences of the Ukrainian SSR., 1944.) 15 roubles.*

DOWD, MARY T., and DENT, ALBERTA. Elements of Foods and Nutrition. Second edition. Demy 8vo. Pp. xii +357. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1946.) 13*s.* 6*d.* net.

Anthropology : Archæology

ELWIN, VERRIER. Folk-Tales of Mahakoshal. (Specimens of the Oral Literature of Middle India: Published for *Man in India*.) Demy 8vo. Pp. xxv + 523. (London: Oxford University Press, 1944.) 25*s.* net.*

REISNER, GEORGE ANDREW. A History of Giza Necropolis. Vol. 1. Sup. Roy. 4to. Pp. xlvii + 532 + 75 plates. (Cambridge, Mass.: Harvard University Press; London: Oxford University Press, 1946.) £7 7*s.* net.

SAHU, LAKSHMI NARAYANA. The Hill Tribes of Jeypore. Roy. 8vo. Pp. v + 205 + viii + 17 plates. (Cuttack: Orissa Mission Press, n.d.)*

SUMMERS, MONTAGUE. Witchcraft and Black Magic. Med. 8vo. Pp. 228 + 16 plates. (London: Rider and Co., Ltd., 1946.) 28*s.* net.*

Miscellany

BALLY, GUSTAV. Vom Ursprung und von den Grenzen der Freiheit: eine Deutung des Spiels bei Tier und Mensch. Med. 8vo. Pp. 140. (Basel: Benno Schwabe und Co., 1945.)*

HART, CAPT. B. H. LIDDELL. The Revolution in Warfare. Cr. 8vo. Pp. 99. (London: Faber and Faber, Ltd., 1946.) 5*s.* net.*

HEATH, SIR H. FRANK, and HETHERINGTON, A. L. Industrial Research and Development in the United Kingdom: a Survey. Demy 8vo. Pp. xiii +375 +23 plates. (London: Faber and Faber, Ltd., 1946.) 25*s.* net.*

HIGGINSON, N., and HIGGINSON, J. H. Great Adventure: Pioneer Studies for Action in Education. Cr. 8vo. Pp. x +136. (London: University of London Press, Ltd., 1945.) 4*s.* 6*d.* net.*

LEWIS, H. K. Lewis's, 1844–1944: a Brief Account of a Century's Work. Fcap. 4to. Pp. x + 90. (London: H. K. Lewis and Co., Ltd., 1945.) Free.*

PEACE. First Spring of Peace. Roy. 4to. Pp. xxx + 96. (London: Contact Publications, Ltd., 1946.) 3*s.* 6*d.**

SPENCER-BRAGG, ARTHUR W. "999—Emergency!" (Social Science Series, No. 4.) Cr. 8vo. Pp. 64. (London: Social Science Association, 1946.) 2*s.* 6*d.**

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New I.C.I. Laboratories for Fundamental Research

Imperial Chemical Industries, Ltd., have leased the house and laboratories at The Frythe, Welwyn, Herts, for long-term general and academic research in branches of biological, chemical and physical science. Among the subjects to be studied are the antibiotic products of moulds, kinetics of continuous chemical reactions and the deformation of materials under high stresses of short duration. Work will also be done on the design of industrial instruments and on industrial toxicology. The new laboratories will eventually house twenty or more senior research workers, with assistants and administrative staff. Some of the staff have already been recruited, but have hitherto been scattered in various localities while engaged on war-work. The premises at The Frythe are intended as temporary accommodation until a site at Butterwick Wood, near St. Albans, which was originally selected, can be developed. The activities of the Butterwick Research Laboratories will be completely independent of all other I.C.I. research departments, which will continue to be concerned with more specifically industrial problems.

Colour Receptors in the Human Fovea

Dr. F. W. Edridge-Green suggests that, if Prof. Hartridge's observations in *Nature* of July 20 were correct, the stars should appear to change colour as their light falls upon different cones of the fovea. Prof. Hartridge, in reply, says "Dr. Edridge-Green is quite right. On either the three-colour theory of Thomas Young, or on its modern counterpart, the Wundt–Granit hypothesis, one would expect a point source, and therefore a star, to undergo subjective changes of colour as its image is caused to move over the retina. Some stars do change colour, a fact usually explained on purely physical grounds; I have also noticed changes of colour of local sources under conditions where physical explanations did not appear to apply (*Nature*, July 20, p. 97). Why, it may be asked, are such colour variations so seldom seen when the eye is being used in normal vision? The answer is not a simple one, since many factors play a part. In the first place the retinal image, even of a point source, falls on a considerable area of retina. This is partly due to diffraction, and partly due to aberrations. In consequence, many photoreceptors are usually stimulated at the same time. But further, colours which would normally be seen are eliminated by the anti-chromatic responses. In the third place, there is a process which tends to smooth out differences in response. This is now under further investigation, because it is hindering progress. When a method has been found of putting this process temporarily out of action, a new avenue of approach to the essential problem of vision will probably have been found."

Catalogue of Huxley's Papers and Correspondence

In 1937, through the good offices of the Friends of the National Libraries, the correspondence and papers of Thomas Henry Huxley were presented to the Imperial College of Science and Technology, London. During the War, these papers were necessarily inaccessible, but as soon as it became safe to bring them out of hiding, the governing body of the College decided that they should at once be made available, and the work of arranging and cataloguing them was entrusted to Mr. Warren R. Dawson, who has had much experience of work of this nature and has previously published catalogues of various collections of scientific papers such as the Smith manuscripts of the Linnean Society, and the entire manuscript collection of the Medical Society of London. The arrangement of the Huxley Papers has been accomplished, and a complete descriptive catalogue of the entire collection has been prepared; it will be published shortly by Messrs. Macmillan & Co., Ltd., St. Martin's Street, London, W.C.2. The collection comprises some five thousand letters, and a large mass of other papers covering the entire range of Huxley's manifold activities—biology, anthropology, education, philosophy, and many other subjects in which he interested himself, and upon which he left his mark. The catalogue should be of great value in the study of the history of science during a brilliant phase of its development.

Publication and Distribution of Scientific Papers

In a paper presented before the American Association for the Advancement of Science at its Cleveland meeting on September 11, 1944, Zeliaette Troy, librarian of the Boyce Thompson Institute for Plant Research, reiterated earlier proposals for dealing with the mechanical side of the publication and distribution of scientific papers originally outlined in *Special Libraries* in July–August 1943. It is urged that the whole problem is purely a matter of good business management and should be considered factually. To centralize the printing of scientific papers and abstracts in one establishment covering all sciences and technologies—presumably, one for each country—would offer all the advantages of modern mass-production methods in the mechanical aspects such as paper and ink supplies, printing and indexing by specialists, apart from the comprehensive service which could be offered to any subscriber or reader in the field he designated. The central organisation is visualized as a limited company in which the shares are held by the various organisations interested in publishing and purchasing scientific and technical papers; original research articles and summary-review articles would be published and sold in much the same way as U.S. patent specifications, and the abstracts journal would be analogous to the *Official Patent Office Gazette*.

Industrial Development of Northern Rhodesia

The first report of the Advisory Committee on Industrial Development, Northern Rhodesia (Lusaka: Government Printer, 1946. 1*s*.) recommends the renewal of a number of customs agreements as well as a clear statement of policy on the extent to which the African will be allowed to participate in semi-skilled or skilled labour, and the enactment of legislation to prevent dumping. The Committee recommends that the Government's undertaking to develop Ndola as the commercial and distributive centre of the Copperbelt be rescinded, and secondary industries be allowed to select any location convenient for them, including the four Copperbelt townships. It also welcomes the formation of a Statistical Department as visualized by the Central African Council, and in the meantime requires the services of a full-time technical officer. Of a number of agricultural products examined with a view to their processing or industrial utilization, cassava holds possibilities for the production of starch as a secondary industry. Evidence is against the successful establishment of a cotton-

growing industry, but there are a number of essential oils the development of which might repay close investigation, and further experiment on the cultivation of tung oil by the Agricultural Department is recommended. After a thorough examination of all phases of a cement factory in Northern Rhodesia, the Committee considers that the establishment of this industry holds little prospect of financial success unless a territorial consumption of 20,000 tons a year can be guaranteed for at least fifteen years. Complete information on the coal resources of the Territory is being assembled, and the manufacture of cycles and fibre board, and the formation of a central logging organisation have also received attention. Proposals are advanced for developing the tourist industry, and a memorandum has been submitted to the Government on the importance of increasing the existing power services. There are good technical and economic prospects for a small sheet metal industry to process utensils for African trade, and support is urged for the establishment of the fishing industry on a sound basis. Publication in booklet form of complete information on the mineral resources of Northern Rhodesia is recommended.

Safety of Malaysian Hepaticæ in Germany

THE Farlow Herbarium of Harvard University has received word that a valuable collection of more than three thousand specimens of Malaysian Hepaticæ, chiefly epiphytic Lejeuneaceæ gathered by Dr. Frans Verdoorn as well as some other collections assembled by him between 1925 and 1936, which were on loan, at the outbreak of the War, to the Botanical Institute of the University of Jena, is safe. Prof. Th. Herzog who, with a number of assistants and graduate students, is working on this collection writes that he placed most of it, during the early war years, for safeguarding in a country home near Jena. This house was almost entirely destroyed by a bomb; the specimens, however, were found in undamaged condition in the wreckage of the basement. They were later removed to a part of the basement at the Botanical Institute. This building and most of the basement were entirely destroyed at a later date when nine students were killed and the director, Prof. Renner, was seriously wounded. The bryological collections were fortunately in a wing where the basement withstood the bombing, and work on them is now being continued by Prof. Herzog and his assistants, Drs. Benedict and Schuchardt.

Sixth International Congress on Experimental Cell Research

THE Sixth International Congress on Experimental Cell Research is to be held in Stockholm in July 1947. The Congress will be organised by a Swedish working committee. Prof. J. Runnström of Wenner-Grens Institute will act as chairman for the Conference and Prof. T. Caspersson and Dr. H. Hyden of the Karolinska Institute as secretaries. A preliminary programme will be published at the beginning of the autumn. The Conference will include a series of symposia on important problems in experimental cell research from the physico-chemical, physiological and morphological aspects. The Swedish organising committee hopes that cell research workers of all kinds will take advantage of this occasion for exchanging experiences and renewing contact with their colleagues. Suggestions or questions regarding the Conference should be sent to the secretaries.

The Night Sky in September

FULL moon occurs on Sept. 11d. 09h. 59m. U.T. and new moon on Sept. 25d. 08h. 45m. The following conjunctions with the moon take place: Sept. 21d. 04h., Saturn 4° S.; Sept. 27d. 13h., Jupiter 3° S.; Sept. 27d. 16h., Mars 4° S.; Sept. 29d. 00h., Venus 7° S. In addition to these conjunctions with the moon, the following conjunctions occur: Sept. 4d. 03h., Venus in conjunction with Jupiter, Venus 3·5° S.; Sept. 25d. 04h., Mars in conjunction with Jupiter, Mars 1·1° S. There is an occultation of ν Psc, reappearance taking place on Sept. 14d. 01h. 56·2m. Mercury rises about an hour before the sun on Sept. 1 and can be seen in the eastern sky. The planet is in conjunction with the sun on Sept. 14 and is not favourably placed for observation during the greater portion of the month. Venus sets an hour after the sun on Sept. 1 and 45 minutes after the sun on Sept. 30, attaining its greatest eastern elongation on Sept. 8. During the month the stellar magnitude of Venus varies from $-3{\cdot}9$ to $-4{\cdot}2$. Mars and Jupiter are unfavourably placed for observation. Saturn rises at 2h. on Sept. 1 and at 0h. 19m. on Sept. 30 and can be seen in the constellation of Cancer in the morning hours. Its stellar magnitude is 0·5 during the month. Autumn equinox occurs on Sept. 23d. 16h.

Announcements

UNDER the auspices of the Central University, Quito, Ecuador, a general scientific review covering pharmacy, chemistry, physics and biology has been published under the title *Revista de la Asociacion Escuela de Quimica y Farmacia*. The Director (University, Quito, Apartado No. 166) is anxious to keep in touch with scientific developments everywhere and requests exchanges with similar reviews in America and the Old World.

The Royal Society of New Zealand invites applications for the T. K. Sidey Summer Time Award of a bronze medal and a prize of £100. The award is made for scientific research on any kind of electromagnetic radiation (visible or invisible), including its relation to human welfare. Further information may be obtained from the Secretary, Royal Society of New Zealand, Victoria University College, Wellington, New Zealand.

THE report of proceedings of the twentieth conference of the Association of Special Libraries and Information Bureaux includes the papers presented at the Conference last September (see *Nature*, 156, 605; 1945) together with notes on the discussions and reports on the work of the ASLIB Microfilm Service and on the British Union Catalogue of Periodicals, and notes on the National Central Library and the Inter-Allied Book Centre. There is also a brief summary of a paper by Mr. E. Reid on the reform of the system of scientific publication by basing it on the individual paper as the unit. Charts displayed at the Conference showing the growth and distribution of the membership of the Association have been reproduced. Additions to the list of desk reference books given by Miss M. Bateman in her paper and suggested by members during the discussion are collected in a useful appendix to that paper.

LETTERS TO THE EDITORS

The Editors do not hold themselves responsible for opinions expressed by their correspondents. No notice is taken of anonymous communications

Fixation Area in the Human Eye

USING the micro-stimulation apparatus referred to in a recent communication, further experiments have now been performed with the object of elucidating the process of visual fixation. It was found that there was a small scotoma (blind spot) for red rays, which was situated in my own fovea, about seven cone units away from the fixation point for green rays. Since it is unlikely that this spot alters its position on the retina, successive determinations of the position of the fixation point for green rays, relative to this spot, enables any changes in the former to be detected. The fixation point for green rays (5,200 A.) was found in this way to be very constant in position (see Table 1).

TABLE 1. POSITION (IN CONE UNITS) IN VISUAL FIELD OF FIXATION POINT FOR GREEN RAYS, RELATIVE TO BLIND SPOT FOR RED RAYS

Series 1		Series 2		Series 3	
Above by	To right by	Above by	To right by	Above by	To right by
4·60 c.u.	1·00 c.u.	5·5 c.u.	0·8 c.u.	5·0 c.u.	1·4 c.u.
4·65 ,,	1·00 ,,	4·9 ,,	0·7 ,,	6·0 ,,	1·8 ,,
4·70 ,,	1·15 ,,	5·0 ,,	1·1 ,,	5·2 ,,	1·8 ,,
4·60 ,,	1·05 ,,	5·4 ,,	1·2 ,,	4·4 ,,	0·3 ,,
4·70 ,,	0·90 ,,	5·2 ,,	0·7 ,,	4·4 ,,	1·1 ,,
		5·5 ,,	0·6 ,,	5·7 ,,	0·2 ,,
Means 4·65 ,,	1·20 ,,	5·4 ,,	1·2 ,,	4·4 ,,	1·7 ,,
		4·8 ,,	1·3 ,,		
		Means 5·21 ,,	0·95 ,,	Means 5·01 ,,	1·18 ,,

The first series was made keeping the conditions as uniform as possible. During the second series, made the following evening, alterations were carried out in most parts of the apparatus, such as rotating the eyepiece, rotating the objective, replacing the mirror by a different one, etc. During the third series, made about a week later, alterations were made in the adaptation, and degree of accommodation of the eye, etc. It will be noticed that the green fixation point altered scarcely at all in position during the period covered by these tests.

The conclusion, from the above experiments, is that one particular retinal receptor is performing the function of fixation during the time that green rays are being used for visual purposes.

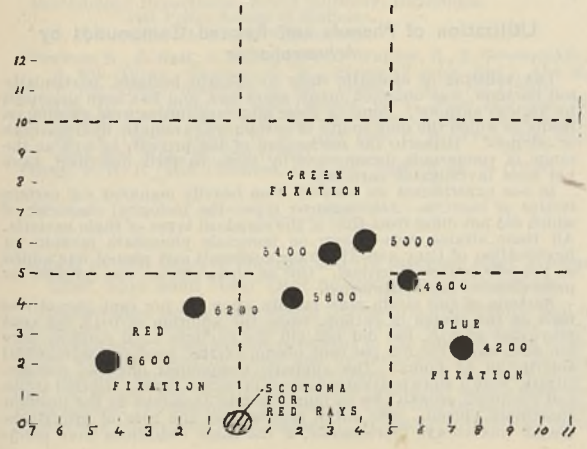
Experiments were now performed to determine the positions of the fixation points for other colours: red, orange, yellow, blue-green, blue and violet. The results, which are given in Table 2, are plotted in the accompanying chart.

It will be seen that the red and orange fixation points fall within what was called, in a previous communication, "the red fixation area". The yellow, green, and blue-green fixation points fall similarly within "the green fixation area". The violet fixation point lies within "the blue fixation area"; while the blue one is at the border of that area. Thus the results previously obtained are confirmed.

It seems very unlikely that the fixation points for a particular colour would occur in a region devoid of receptors of that colour. The converse was considered more likely. This points to the existence of clusters of sense organs of similar, or nearly similar, response, thus supporting the cluster hypothesis. The existence of all these different fixation points indicates the presence in the fovea of sense organs of all these different kinds, thus supporting Granit's hypothesis. Additional evidence has been obtained on this point, using the micro-stimulator, by causing a small colourless source to move slowly over the surface of the retina, when it was seen in the following colours: red, orange, green, pale blue-green, grey-blue. Red was sometimes seen as orange and as pale orange. Orange sometimes appeared red and sometimes very pale orange. Yellow appeared to be red, orange, green, and white. Green at times looked very pale green, occasionally it looked white. Blue looked pale blue-green, or grey. All the above colours are probably modified by the dichromatism, caused by the anti-chromatic responses.

TABLE 2

Fixation for	Wave-length	Vertically above by	Horizontally left or right by
Red	6600	2·1 c.u.	4·4 c.u. left
Orange	6200	3·9 ,,	1·5 ,, ,,
Yellow	5800	4·2 ,,	1·7 ,, right
Green	5400	5·7 ,,	3·0 ,, ,,
Blue-Green	5000	6·1 ,,	4·2 ,, ,,
Blue	4600	4·8 ,,	5·6 ,, ,,
Violet	4200	2·6 ,,	7·4 ,, ,,



The evidence in favour of the Wundt–Granit hypothesis is summarized in Table 3.

TABLE 3

Red	—	*F*	*M.S.*	P_1	*R.D.*
Orange	*G*	*F*	*M.S.*	—	—
Yellow	*G*	*F*	—	P_2	*R.D.*
Green	*G*	*F*	*M.S.*	P_1	*R.D.*
Blue-Green	*G*	*F*	*M.S.*	—	—
Blue	*G*	*F*	*M.S.*	P_1	*R.D.*
Violet	*G*	*F*	—	—	—

G = Granit's micro-electrode experiment on animals.
F = Author's fixation method.
M.S. = Author's micro-stimulation method.
P_1 = Primary colour on Young's trichromatic theory.
P_2 = Primary colour according to Hering, Donders and G. E. Müller.
R.D. = Retinal direction effect of Stiles and Crawford.

In Table 3 is summarized the evidence in favour of retinal receptors for the different colours mentioned, so far as it is known at present. Further experiments on these lines are in progress.

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Concentration of Visual Purple in the Human Eye

ACCORDING to the measurements of v.d. Velden[1], the efficiency of the human retina is sometimes nearly 1; every quantum of light that reaches the retina is absorbed. Then it elicits a response of the sense cell[2,3]. An efficiency of 1 would mean that the density of the visual purple is large enough to cause a difference between the sensitivity curve of the dark-adapted eye and the absorption curve of visual purple; so long as a small amount of visual purple is present, the amount of light absorbed at various wave-lengths is proportional to the absorption coefficient. As soon as the density of visual purple is large enough, the absorption at the maximum (505 mμ) becomes relatively smaller. In the extreme case of very high density, the absorption is 100 per cent in a broad region of the spectrum, irrespective of the wave-length, and the maximum at 505 mμ is flattened out.

Therefore one might expect that if a blue (505 mμ) and a yellow field (580 mμ) seem equal to each other after a very short time of adaptation (some minutes), the blue field would become relatively darker than the yellow field after a sufficient time of adaptation. This is not the Purkinje effect, since it is in the opposite direction. (Of course, no colour is seen by the rods; here blue and yellow only refer to the wave-lengths.)

The experimental arrangement was as follows. A white sheet of paper was illuminated by light of the colour-mixing apparatus. The diameter of the test field was 10°; the central part of the field was dark (2°). One half of the field was illuminated by 505 mμ, one half by 580 mμ. An artificial pupil was used, the diameter of which was reduced after some time of adaptation in order to obtain a constant subjective brightness. In three series of experiments, adaptation was followed for three hours. After each series, the match for the light-adapted eye (but for rod vision) was determined again. The third series of measurements was carried out after a vitamin A diet, but the results did not vary.

No influence of adaptation on the match was found, whereas an effect of 5 per cent would have been detected. This means that the absorption of the visual purple was smaller than 10 per cent at 505 mμ. In order to rule out the possibility that the regeneration of visual purple took place in the first few minutes of adaptation, the match of blue and yellow was made within some minutes after light adaptation. This was repeated about ten times, but the match did not differ from the match after some hours of dark adaptation. It is not as yet clear how this result can be brought into line with the findings of v.d. Velden. It may be that the visual purple is more concentrated in some smaller areas. Perhaps it will be possible to find somebody who has more visual purple in the dark-adapted state. This would be very important, as it would give us a possibility of studying the amount of visual purple during dark and light adaptation.

S. Hecht[2] also arrives at the conclusion that the absorption of the visual purple is less than 20 per cent, by comparing the scotopic luminosity curve with the absorption curve of visual purple. Some corrections must be applied to the luminosity curve, however, and therefore the measurements reported here give a useful check on Hecht's results. Moreover, the method reported in this communication does not require complicated apparatus or accurate measurements of the energies of the two fields; and these fields may be obtained by coloured filters, so that the measurements can be repeated by a simple equipment.

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July 16.

[1] Velden, H. A. v.d., *Physica*, **11**, 179 (1944).
[2] Hecht, S., Shlaer, S., and Pirenne, M. H., *J. Gen. Physiol.*, **25**, 819 (1942).
[3] Vries, Hl. de, *Physica*, **10**, 553 (1943).

Ageing of Nerve Cells

THE human brain contains hundreds of different types of nerve cells of varying structures. Each type is found in a circumscribed area, and forms, either on its own or together with a few other types of nerve cells, a grey centre or 'griseum'. As a result of the aggregation of the representatives of one cell type in a circumscribed region, the task of following the life-history of that particular cell type under normal or pathogenic conditions becomes possible, or at least easier. Most representatives of a cell-type mature, age or 'fall ill' simultaneously.

To a large extent, the time course and morphological features of ageing are different in each cell type. The ageing process or 'involution' of a cell is different from any other regressive process or 'degeneration' it may undergo, but degenerative processes may, of course, occur in combination with an involution.

The time of onset of ageing of different cell types is sufficiently determined to permit an average order or 'pattern' of ageing to be established. Thus the cells of the inferior olivary body age particularly early, those of the pons much later, the vital cells of the medulla oblongata very late.

The ageing process always leads to the death of the cell. If it occurs at an average (normal) time, it causes partial death of the brain through normal death of the cell type in question. If a person lives sufficiently long, partial death of the vital cells of the medulla causes his or her death as a normal phenomenon. This form of death is a rare occurrence, because death through disease usually terminates the individual life at an earlier stage.

Mutations may delay or accelerate ageing in general. Frequently, however, their effect is restricted to certain cell types. If their effect is thus strong but circumscribed, it produces the so-called 'systemic involutions'. An example is the premature ageing, in paralysis agitans, of the nerve cells which contain melanin.

External factors may also affect the process of ageing. Arteriosclerosis, temporary hypoxæmia, poisoning (for example, by carbon monoxide) and infections (as in the case of Parkinsonism after encephalitis) may lead to premature ageing.

Lastly, the degree of activity of a particular cell type has a great effect on its ageing process. Destruction of nerve cells which normally stimulate other ganglion cells causes premature ageing of those cells which now receive fewer impulses. After the destruction of the cells of the corpus striatum, for example, there occurs a trans-neural involution of the cells of the nucleus pallidus. On the other hand, involution is delayed not only by normal but also by such excessive activity of nerve cells as results in their hypertrophy. Accordingly, in particularly active individuals the ageing of certain ganglion cells is delayed.

In different cell types, the ageing process produces different counter-reactions. One such reaction is the increase in Nissl granules ('hypertigrosis'), produced by an augmented activity of the nucleolus; another a hyperchromatosis and pyknosis of the nucleus which has hitherto been wrongly interpreted as a degeneration. Another is probably the vacuolization regularly observed during the involution of ganglion cells containing melanin. These counter-measures are particularly conspicuous in active individuals.

It is well known that cell division rejuvenates the cell while it interrupts its work. Division of a nerve cell would, accordingly, temporarily suppress its readiness for action. More important still, division would, by distributing the cell processes between two cells, destroy the adaptation to the reception and emission of impulses produced by the cell's previous activity. Lastly, the correct halving of long processes, for example, of the axons of giant pyramidal cells which are about 1 m. long and about 10 μ thick, appears to be mechanically impossible. It is, for example, known that the fibroblasts of *Triton* which bear processes withdraw these before undergoing cell division. From a functional point of view, however, the long processes of certain nerve cells are essential for an increased integration. We may, therefore, interpret the cessation of nerve cell division during embryonic development as a biological progress useful for selection but achieved at the price of individual death. In the breeding of particularly active individuals lies a possibility of gradually delaying the time of normal cerebral death.

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Pattern of Recovery in Protein Deficiency

REPEATED plasma volume determinations on liberated Indian prisoners-of-war suffering from extreme protein insufficiency have shown that the constituents of the total circulating volume return to normal in a definite sequence. These patients had, at the time they were first studied, a normochromic macrocytic anæmia, a reduced body weight, a reduced serum total protein concentration, confined almost entirely to the albumin fraction, and hence a reduction in the albumin/globulin ratio, a slightly reduced plasma volume and, because of the low hæmatocrit, a significantly reduced blood volume. There was, therefore, a great reduction in the total circulating hæmoglobin and total circulating plasma protein. When the patients were given a diet rich in calories, proteins and vitamins, the above factors returned to normal according to a definite pattern. For the sake of ease of description, the recovery process has been divided into three stages. These are purely arbitrary, and may show considerable variation in their time relations.

Stage 1 (0–4 weeks) is characterized by the rapid rise in plasma volume to normal. During this period the body-weight falls as the œdema disappears and may then slowly rise. The blood-volume rises steadily, but at such a rate that, although the hæmoglobin concentration and the hæmatocrit falls, the total circulating hæmoglobin increases. Although the hæmoglobin concentration falls, the red blood corpuscle concentration usually increases, since at this time the patient's blood is rapidly becoming less macrocytic. The total circulating plasma protein increases, but, because of the rapid rise in plasma volume, the plasma protein concentration changes but little. More albumin is formed than globulin, so the albumin/globulin ratio increases slightly.

Stage 2 (2–12 weeks) is characterized by the rapid rise of both the blood volume and the total circulating plasma protein to normal. The plasma volume, which had attained normal values in Stage 1, increases rapidly to values well above normal. There is also a rapid increase in body-weight and in total circulating hæmoglobin, because both the hæmoglobin concentration, which fell in Stage 1, and the blood-volume are increasing rapidly. The total circulating albumin increases more rapidly than the globulin, but the latter does, however, reach figures in excess of normal. The albumin/globulin ratio continues to increase.

Stage 3 (8–16 weeks) is marked by the transition from Stage 2 to normal values. The plasma-volume, which rose to above normal in Stage 2, returns to normal, and the blood-volume, which had reached normal in Stage 2, remains there. The body-weight, the hæmoglobin concentration and the total circulating hæmoglobin all steadily rise. There is also a steady rise in the plasma protein concentration, but, because of the fall in plasma-volume, the total circulating plasma protein remains the same. There is, however, still a rise in the total circulating albumin, which is balanced by a corresponding fall in the total circulating globulin. This is reflected in the continued increase of the albumin/globulin ratio.

STAGES OF RECOVERY IN PROTEIN DEFICIENCY

	Stage 1 (0–4 weeks)	Stage 2 (2–12 weeks)	Stage 3 (8–16 weeks)
Body-weight.	Decreases.	Increases rapidly.	Increases to normal.
Plasma volume.	Increases rapidly to normal.	Increases rapidly to above normal.	Decreases to normal.
Blood volume.	Increases.	Increases to normal.	No change.
Hb. conc. and Hæmatocrit.	Decreases or no change.	Increases.	Increases to normal.
Total circulating Hb.	Increases.	Increases rapidly.	Increases to normal.
R.B.C. conc.	Increases slightly or no change.	Increases.	Increases to normal.
Plasma protein concentration.	No change or increases slightly.	Increases rapidly.	Increases slightly to normal.
Total circulating plasma protein.	Increases.	Increases very rapidly to normal.	No change.
Total circulating albumin.	Increases.	Increases rapidly.	Increases to normal.
Total circulating globulin.	Increases slightly to normal.	Increases to above normal.	Decreases to normal.
Albumin/globulin ratio.	Increases slightly.	Increases.	Increases to normal.

The above description, which is of necessity an over-simplification, is summarized in the accompanying table. Full details of these findings will be published elsewhere.

I am grateful to the Director of Medical Services, India, for permission to publish this report.

R. J. ROSSITER

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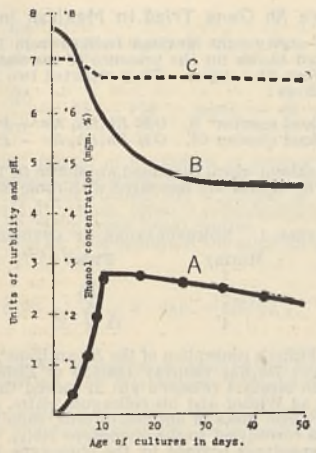
* Other members of the team, Lieut.-Col. J. H. Walters, I.M.S., and Major H. Lehmann, R.A.M.C.

Utilization of Phenols and Related Compounds by *Achromobacter*

THE splitting of aromatic rings by certain bacteria, particularly soil bacteria, was observed many years ago, and has been described by various authors[1]. Some of these micro-organisms were growing on media in which the only source of carbon was aromatic hydrocarbons or phenols[2]. Hitherto the mechanism of the process, as well as the range of compounds decomposed by those bacteria described, have not been investigated carefully.

In our experiments we isolated from heavily manured soil certain strains of bacteria—*Achromobacter* type—the biological character of which did not differ from that of the standard types of these bacteria. All these strains were grown on inorganic phosphate medium (a modification of Grey and Thornton medium[3]) and phenol was added as the sole source of carbon. One of these strains was selected for more detailed experimentation.

Bacteria of this strain grew readily when 0·1 per cent phenol was used as the source of carbon, while the addition of 0·15 per cent prevented growth, but did not kill the bacteria until cultures were ten days old. The 0·2 per cent phenol exerted marked bacteriocidal activity in 48 hours. The aliphatic compounds (glucose, acetate, citrate) were a more convenient source of carbon for the selected strain and produced growth two to four times as abundant as the medium containing phenol. The curve representing the rate of growth on phenol was always reproducible, if the same conditions were main-



A. Bacterial growth estimated nephelometrically, expressed in units of turbidity. Nephelometric estimations were controlled by cell counting. *B*. Phenol concentration, estimated colorimetrically according to Folin. *C*. *p*H of culture

tained. The rate of growth of bacteria in phenol depends on *p*H and reaches its peak at *p*H 7; at this *p*H also phenol disappears most rapidly (see chart).

The strain which has been described, while growing on medium containing 0·2 per cent of glucose and 0·1 per cent of phenol, used both substrates simultaneously. The increase in the number of bacteria was greater than in the case of phenol alone, and the disappearance of phenol markedly decreased.

Achromobacter exhibits high specificity in the utilization of different aromatics as the sole source of carbon. It cannot utilize unsubstituted aromatic hydrocarbons, since it does not grow on benzene or toluene when they are used in the media as free hydrocarbons or their sulphonic acids. The hydrogenation of the benzene ring makes it available to bacterial enzymes, as was shown in the case of cyclohexane, which is a good source of carbon. The introduction into the benzene ring of chlorine, nitro, amino or sulpho groups does not make the compounds available to the bacteria investigated; but the introduction of oxygen enables the benzene ring to be split.

Nearly all the mono-, di- and tri-phenols examined up to now (for example, phenol, *o*-, *m*- and *p*-cresols, catechol, resorcinol, 3,4-xylenol-1-ol, orcinol, pyrogallol) are good sources of carbon for such bacteria, and the essential factor is the presence of the free phenolic group. The phenolic ethers (anisol, phenetol, diphenyl-ether) are not attacked by this strain. The esters of phenol—sulphuric, acetic, benzoic—are readily utilized as the source of carbon. Most probably the enzymatic system of the bacterial cell contains esterases which split the ester linkage, and so render the free phenol available to the bacterial cell.

The introduction of oxygen makes the aromatic ring available for bacteria not only when it is present as a phenolic group, but also as an alcoholic group, for example, benzyl alcohol, or as a carboxyl group. The mono-carboxylic acids derived from benzene (for example, benzoic, phenyl-acetic, anthranilic, salicylic acids) produced even better bacterial growth than phenols. In this connexion it is curious that the two dicarboxylic acids examined, phthalic and terephthalic acids, are not attacked by these bacteria. The keto-derivatives benzophenon and benzil also were not utilized.

The ability to split the aromatic ring is limited to mono-cyclic compounds; all hydroxy and carboxy derivatives of naphthalene examined have failed to maintain bacterial growth when they are the sole source of carbon.

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Urease in the Gastric Mucosa and its Increase after a Meat Diet, Soya Bean Flour Diet or Urogastrone Injections

There is good reason for believing that gastric hydrochloric acid is neutralized by ammonia formed most probably by urease from circulating urea. This enzyme is present in the mucosa. This mechanism was first noted by Luck[1] and by Luck and Seth[2] in the dog and cat, and Linderstrøm-Lang and Ohlsen[3] noted also that in the dog the urease was most potent in the superficial rather than the deep mucosa. Furthermore, Linderstrøm-Lang and Ohlsen[3] held that urease was not present in all animals; for example, they held there was none present in the pig. From personal work we have shown that this ferment exists in at least man, dog, cat, rabbit, pig and rat. The amount in the first three species of animal appears to be much greater than in the latter three. Rigoni[4] had shown its presence in man, and, like Linderstrøm-Lang and Ohlsen, had speculated on its possible significance.

At room temperature as much as 66 mgm. ammonia nitrogen can be formed per hour from the total mucosa of a cat's stomach, this being sufficient ammonia to neutralize 47 ml. *N*/10 hydrochloric acid, far more acid than is formed by any cat's stomach in that time. We know that this quantity of ammonia is not released into the stomach (except, perhaps, in disease) so presumably the ammonia – hydrochloric acid reaction occurs intracellularly. There is some increase in intragastric ammonia coincidental with neutralization in both man and the cat at any rate, but not at all enough to explain the observed degree of neutralization. The urease seems to be present in largest amounts in the fundus, less in the pylorus and very little indeed in the duodenum or small intestine proper (cf. Table 1).

Table 1. Ammonia nitrogen (mgm.) released from urea per gram of dried mucosa per hour at room temperature from cats fed only on milk and from cats fed on milk plus excess meat in the form of lungs and liver. Figures in brackets show number of animals used

	Sup. upper stomach	Deep upper stomach	Sup. lower stomach	Deep lower stomach	Sup. duodenum	Deep duodenum
Milk fed	4·03 (7)	1·99 (8)	4·43 (8)	0·47 (8)	0·26 (5)	0·30 (5)
Meat fed	16·25 (15)	17·31 (15)	11·94 (14)	16·86 (14)	0·18 (11)	0·31 (11)

The amount of urease which is present varies from species to species, as has been noted above; but inside the same species the concentration of mucosal urease can be increased by any one of the three following methods: by high protein diet, by soya bean flour diet or by injections of concentrated pregnancy urine. Of the first of these, experiments in cats have shown that if an animal be placed on a high protein diet, it accumulates a far higher concentration of urease at the end of as little as a week, compared with the animal placed on a milk diet (cf. Table 1). It will be noted from the table that the concentration increase is quite definite and that apparently this increase in concentration is more remarkable in the deeper part of the mucosa of the stomach, both upper and lower, than it is in the superficial. The effect on the duodenal content of urease seems to be negligible.

Table 2. Ammonia nitrogen (mgm.) released per gram per hour from dried gastric mucosa of rats incubated at 37° C. with urea. Animals fed previously on soya bean flour or injected with 0·3–0·6 ml. antuitrin S. Figures in brackets show number of animals used

	Upper stomach	Lower stomach	Duodenum plus intestine
Soya bean fed	2·38 (7)	1·10 (6)	0·67 (5)
Control normal fed	1·29 (6)	0·66 (5)	0·71 (5)
Antuitrin S injected	1·85 (5)	1·42 (5)	0·40 (5)

The second finding, in relation to soya bean flour, was tried only on rats; in these animals it is not practicable to divide the mucosa into superficial and deep, while mucosæ had to be analysed in groups of at least three, owing to the very small amounts obtainable (cf. Table 2). Again, there is little change in the intestinal content of the ferment. Soya bean flour was used as, though it is not active itself as a urease enzyme, the enzyme having been destroyed in preparation, it presumably contains a good remnant of the specific protein of urease which normally is present in the soya bean.

Finally, concentrated pregnancy urine was used in the form of Parke Davis Antuitrin S. in amounts varying in different experiments from 0·3–0·6 ml./rat/day from 10–20 days. This extract probably contains a high content of urogastrone. Again, this work has had to be done on rats, and the results are tabulated in Table 2. A definite increase in concentration can be noted.

These three groups of experiments are interesting in so far as they show that the content of a ferment can be varied at the will of the investigator. The presence of urease in such concentrations in the gastric mucosa must have a role in the protection of the mucosa from digestion by acid pepsin. Its involvement in neutralization of hydrochloric acid is being further studied.

I wish to acknowledge with gratitude the receipt of grants from the Medical Research Council of Ireland.

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July 26.

[1] Luck, J. M., *Biochem. J.*, **18**, 814 and 825 (1924).
[2] Luck, J. M., and Seth, T. N., *Biochem. J.*, **18**, 1227 (1924) and **19**, 357 (1925).
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[4] Rigoni, M., *Arch. Ital. de Biol.*, **84**, 74 (1931).

Conditioned Pyridoxine Deficiency in Rats on Diets Containing Flours of Different Extraction-Rates

THE occurrence of what is considered to be a conditioned pyridoxine deficiency in rats receiving a diet of high aneurin content has previously been reported[1]. The deficiency was recognized by the running screaming fits and convulsive seizures observed in the suckling rats, and the absence of fits in the litters of does which were given a supplement of 40 μgm. pyridoxine daily from parturition. In the basal group with a low vitamin B_1 intake, no fits were observed, and the weight graphs of the litters were normal. The basal diet used in the experiments contained about 61 per cent of white flour, and it was observed, although not reported, that in spite of high vitamin B_1 intake, no fits occurred in the litters of a few rats which had received from parturition the same basal diet with National wheatmeal flour (85 per cent extraction) substituted for white flour.

The effect of extraction-rate on the occurrence of this conditioned deficiency has been investigated in a recent series of experiments. The diet used contained the following percentages of constituents: wheat flour, 60·9; commercial casein, 23·9; dried brewers' yeast, 1·9; salt mixture (McCollum 185, with iron citrate), 2·0; calcium carbonate, 0·5; and vitaminized margarine 10·8, with vitamins A, D and E, and small amounts of potassium iodide and manganese sulphate as previously detailed. The flour was of 72, 77, 80 or 85 per cent extraction, all the samples being prepared from the same batch of wheat. We are indebted to Dr. James Sword, Cereal Laboratory, Scottish Co-operative Wholesale Society, for kindly supplying us with these samples. Each group received the high-level addition of aneurin used in the previous experiment, which on the white flour diet gave a vitamin B_1 intake of approximately 11·27 μgm. per Cal.

Growth. Normal rats of comparable initial weights, fed *ad libitum* from weaning on the experimental diets, which differed only in the extraction-rate of the flour used, showed considerable differences in weight after a test period of eight weeks. On the diets containing 72, 77, 80 and 85 per cent extraction flour respectively, the weight increases for the males averaged 191·0, 200·4, 203·7 and 226·8 gm., and for the females 129·8, 152·3, 150·9 and 157·8 gm. In a group which received the 72 per cent flour diet with a pyridoxine supplement of 40 μgm. daily per rat, the males showed an average weight increase of 198·4 gm. and the females 149·1 gm. in the 8 weeks' period.

Breeding Performance. Eight weeks after weaning, the females in each group were mated with males from the same group, and the marked differences found in the breeding performance are summarized in the following table, which indicates the incidence of the characteristic fits due to the conditioned pyridoxine deficiency in the various groups.

Group	Flour (% Extraction)	No. of litters born	Observed fits*		Av. weaning wt. of litters (gm.)
			No. of litters showing fits	Approx. no. of individual fits	
A	72%	7	7	110	34·3
C	77%	7	6	43	39·1
D	80%	7	2	13	43·5
E	85%	8	0	0	44·8
B	72% +pyridoxine	6	0	0	42·1

* The rats in all groups were under observation for the same period daily, which was approximately eight hours.

It appears that there is a progressive diminution in the degree of the conditioned pyridoxine deficiency as the extraction-rate of the flour is raised, so that with the 85 per cent flour the imbalance of B factors caused by excessive intake of vitamin B_1 has been corrected sufficiently to prevent the occurrence of the fits typical of this deficiency. It will be noted that there is also a progressive increase in the weaning weights of the young rats with the rising rate of extraction, the difference between the 72 and 85 per cent groups amounting to 10·5 gm. per rat.

Weight of Thymus. The average thymus weights of the rats at weaning in this series of experiments were as follows:

Mean Thymus Weights (gm./100 gm. body weight)

Group	*A*	*B*	*C*	*D*	*E*
Female weanlings	0·254	0·345	0·320	0·328	0·330
Male weanlings	0·205	0·317	0·261	0·280	0·317

For our stock weanlings the values usually found for thymus weight lie between 0·30 and 0·40 gm. per 100 gm. body weight, with an average of about 0·35 gm. The figures illustrate the tendency we generally find in weanling rats for the thymus of the females to be heavier than that of the males. Further, the low values for Group *A* are in accordance with our usual findings in pyridoxine deficiency. When these lower values are considered in conjunction with the lower weaning weight of the group, it will be seen that the absolute reduction in weight of the thymus of these young rats is very considerable. It is known that vitamin B factors other than pyridoxine affect the development of the thymus after weaning, and the higher weights found in Groups *C*, *D* and *E* may doubtless be ascribed in part to the influence of these other factors; but the values found in Group *B* would indicate that pyridoxine alone plays a large part in promoting the development of the thymus before weaning.

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[1] Richards, M. B., *Brit. Med. J.*, i, 433 (1945).

A Rare *Rh* Gene Triad in Mexican Indians

IN a series of ninety-eight Mexican Indians from Tuxpan, Wiener and others[1] tested bloods for the presence of the antigens *A*, *B*, *M*, *N*, *P*, and also four *Rh* antigens. They reported two findings in their first table as follows:

Blood number 9. $OM\ Rh_1Rh_2\ Hr-\ P-$
Blood number 63. $OM\ Rh_1Rh_2\ Hr-\ P-$

The four *Rh* antisera which they used are shown in Table 1, in which the names used by Wiener are compared with those of Fisher. Cappell and myself.

TABLE 1. NOMENCLATURE OF ANTISERA

Wiener	Murray	Fisher	Cappel
Anti-*Rh'*	1	Γ	Anti-*C*
Anti-*Rh''*	2	H	Anti-*E*
Anti-Rh_0	3	Δ	Anti-*D*
Anti-*Hr*	4	γ	Anti-*c*

According to Fisher's conception of the *Rh* antigens[2], it is impossible for bloods of type Rh_1Rh_2 (Murray 153/423 or Fisher *CDe/cDE*) to fail to react with serum 4 (Fisher's γ). If indeed their anti-*Hr* is a potent serum 4 as Wiener and his colleagues claim, and it does not miss occasional single doses of antigen in cells, then the reactions of these two bloods correspond to the phenotype Rh_{123}.

The possible genotypes covered by the phenotype Rh_{123} are shown in Table 2, in which 153/123 (Rh_1Rh_2) is much the least rare. The existence of this rare type has been proved in Britain, and the inheritance of the gene triad 123 (*Rh*$_2$) has been traced in a fortuitous family pedigree[3].

TABLE 2

Possible genotypes	Phenotype	Reaction with antisera 1 2 3 4
Rh_1Rh_2 153/123 $Rh'Rh_2$ 156/123 Rh_1Rh_y 153/126 Rh_2Rh_2 123/123 Rh_2Rh_y 123/126	Rh_{123}	+ + + −

Since both Race[4] and I[5] have found that the frequency of the type Rh_{123} in the British population is only 1 in 1,000, it is remarkable that two such phenotypes should have been found in less than a hundred cases in Mexican Indians. It appears, therefore, that the gene triad 123 (*Rh*$_2$) is not so rare in Mexican Indians as it is in the British. It will be interesting to see the relative frequency of this uncommon gene triad in all races, especially in view of the recent suggestion of Fisher and Race[4] that rare types can arise from common ones by crossover of genes.

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[2] Race, R. R., *Nature*, **153**, 771 (1944).
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[5] Murray, J., *Brit. J. Exp. Path.*, **27**, 102 (1946).

Transfer of Energy Between Centres in Zinc Sulphide Phosphors

IT is well known that the colour of luminescence from zinc sulphide phosphors with at least two types of activator is dependent on the character and intensity of the exciting radiation and also on the temperature. Measurements of the temperature-dependence of the separate emission bands characteristic for each of the activators show that it is very probable that above a certain temperature a transfer of energy takes place from one centre to another. The decrease of the intensity of the blue band above a certain temperature is nearly always accompanied by an increase of the green band. Similar results are obtained for the blue and yellow bands in a phosphor activated with silver and manganese. These and other phenomena can be explained by the following considerations.

Introduction of impurities into a zinc sulphide crystal generally produces new levels between the top of the full S− − band and the bottom of the empty Zn+ band of the pure lattice. These levels, which are normally occupied, can be emptied either by direct ionization through absorption of a light quantum in the impurity centre or by the transfer of an electron to a hole in the full band, the latter arising from the excitation of an electron from the full S− − band to the conduction band. Recombination of free electrons and holes in the impurity levels is responsible for the luminescence. An electron of the full band may also be transferred to an empty impurity-level of an ionized luminescence centre by thermal excitation or by absorption of an infra-red quantum. The hole thus transferred from this level to the S− − band may travel through the lattice until it is recaptured by a similar level or captured by another impurity level.

In this way energy transfer between the centres of different kinds will take place mainly from centres the levels of which are close above the S− − band to a centre in which this distance is larger. Let us assume that in a zinc sulphide phosphor with only blue and green centres the levels belonging to the blue centres are nearer to the full band, and that the transfer of a hole from a green centre back into the full band by thermal excitation is unlikely. We then have during excitation under equilibrium conditions:

$$\frac{dg}{dt} = rq - \alpha_g ng + cb = 0,$$

$$\frac{db}{dt} = (1 - r)q - \alpha_b nb - cb = 0;$$

in which q is total number of ionizations of centres per unit time, rq is number of ionizations of green centres per unit time, n is number of free electrons per unit volume, $g(b)$ is number of holes in green (blue) centres per unit volume, $\alpha_g(\alpha_b)$ is recombination coefficient for free electrons and holes in green (blue) centres.

If the cross-section for hole-capture is the same for green and blue centres, then c is given by

$$c = \frac{G}{G + B} s \cdot \exp - E/kT,$$

where $G(B)$ is number of unexcited green (blue) centres per unit volume, s is a constant, and E is distance between 'blue level' and full band.

It can be shown with these equations that the ratio of the intensities of the green and blue emissions during excitation is given by

$$\frac{I_g}{I_b} = \frac{r + c/\sqrt{\alpha q}}{1 - r}, \quad . \quad . \quad . \quad . \quad (1)$$

if $\alpha_g = \alpha_b = \alpha$.

Increasing the temperature increases c, and the colour changes towards green. Increasing the exciting intensity increases q and thus promotes the blue emission. This is in accordance with the observed facts.

While this work was in progress, we received an article of M. Schön[1] published during the War in which in general terms an indication of an explanation along similar lines is given for the colour change of zinc sulphide phosphors with blue and green emission bands.

During phosphorescence the transfer of holes will continue until there is none left in the blue centres. The colour change from blue to green during the afterglow therefore occurs sooner at higher temperatures.

The temperature-dependence curve for the blue band in such a phosphor is given by

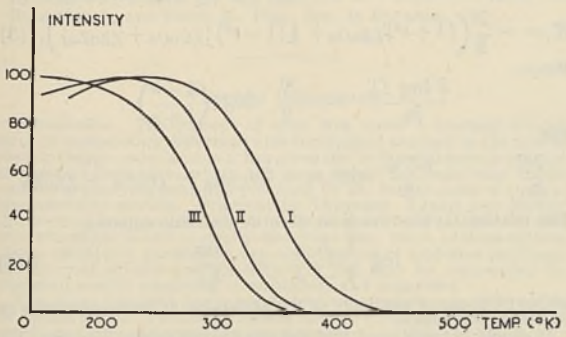
$$\frac{I}{I_0} = \frac{1}{1 + c/\sqrt{\alpha q}}, \quad . \quad . \quad . \quad (2)$$

where I_0 is maximum intensity of the blue band.

$T_{1/2}$, the temperature of 50 per cent quenching ($I/I_0 = \frac{1}{2}$), is thus dependent on the value of q. Increasing the density of excitation by increasing the intensity or by using short-wave ultra-violet or cathode ray excitation shifts the whole temperature-dependence curve towards higher temperatures. This has been confirmed for several zinc sulphide phosphors. $T_{1/2}$ of the blue band is also dependent on the ratio $G/(G + B)$ and is lowered if this ratio is increased. Other centres will have the same effect on the temperature-dependence of the blue band if the distance between the corresponding level and the S— — band is larger than that for the blue centres. Such centres are produced, for example, by the introduction of nickel into the lattice, and the accompanying graph shows some temperature-dependence curves of the blue band in zinc sulphide-silver phosphors which contain the same amount of silver but different amounts of nickel.

The nickel centres differ from the green copper centres in that they do not produce any visible radiation. A radiation in the infra-red could not be detected.

Addition of nickel to zinc sulphide-copper phosphors has a similar effect on the green emission of these phosphors. It therefore follows that the levels belonging to the nickel centres are at a still greater distance from the S— — band than those belonging to the green centres.



INFLUENCE OF NICKEL ON THE TEMPERATURE-DEPENDENCE CURVE OF THE BLUE EMISSION IN ZINC SULPHIDE PHOSPHORS WITH THE FOLLOWING ADDITIONS.

I. 10^{-2} per cent silver
II. " 2×10^{-4} per cent nickel
III. " 10^{-3} per cent nickel

During decay the holes will be transferred from the blue and green centres towards the nickel centres. This explains the killing of afterglow by addition of very small amounts of nickel.

Exposure to infra-red light has a similar effect to heating. It was shown experimentally that the decrease in intensity when irradiating with infra-red light during excitation with ultra-violet (*Tilgung*) depends on the number of killing centres (such as nickel-centres). The *Tilgung* also increases when decreasing the intensity of the ultra-violet, keeping the infra-red intensity constant, as is to be expected from the theory.

Fuller accounts of this work, which is being carried out with the collaboration of S. Rothschild and C. G. A. Hill, will be published elsewhere.

I wish to thank Mr. J, A. M. van Moll and the directors of Philips Lamps, Ltd., for permission to publish this work.

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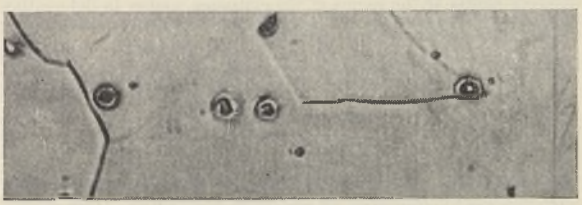
[1] Schön, M., *Z. Phys.*, **119**, 470 (1942).

Electrolytic Detection of Small Amounts of Lead in Brass or Zinc

THE electrolytic polishing of multi-phase metals is usually more difficult than that of single-phase metals owing to differing properties, such as electrode potential, of the different phases. This difficulty may be turned into a helpful factor in certain cases. Thus lead may be detected and identified in brass or zinc by making use of the local cell set up between the lead and the ground-mass.

In a 70/30 brass specimen containing 0·1 per cent lead electrolytically polished for 2 min. at 2·5 volts in orthophosphoric acid of specific gravity 1·5, all particles appeared under the microscope as relatively shapeless dark areas. Polishing for 2 min. at 2·5 volts, then for a further 2 min. at 1·8 volts without removing from the solution produced the same result. Reducing the voltage to 1·6, however, produced the structure shown, most particles being now ringed by a 'moat'. Comparison with 70/30 brass specimens free from lead and with others containing 0·005, 0·02 and 0·05 per cent respectively showed the ringed particles to be due to lead; the lead-free specimen showed no ringed particles and the others showed increasing amounts. For all the leaded specimens the transition from unringed to ringed lead particles occurred between 1·8 and 1·6 volts, the voltage being lower the higher the copper content. Some particles were unaffected by voltage changes from 0·5 to 2·5 volts; it was concluded that these were not lead, and this was confirmed by their slight angularity, which was known from observation of hand-polished specimens to be a characteristic of non-lead inclusions.



RINGED LEAD PARTICLES IN ELECTROLYTICALLY POLISHED 70/30 BRASS. × 1,000

The origin of the 'moat' effect appears to be as follows. During the initial polish at 2·5 volts a mound of precipitate forms on each lead particle and spreads a little over the surrounding brass. This accounts for the enlarged apparent size of the particles observed after electrolytic polishing. Owing to the local cell set up by each lead particle, with the lead cathodic to the surrounding brass, the current carried by the lead is reduced to zero at an applied voltage of 1·6, the mound of precipitate dissolves and increased solution of the adjacent brass occurs. According to this explanation, the critical voltage of 1·6–1·8 is equal to the local cell potential in the solution in contact with the specimen, and would therefore be expected to decrease with increase in copper content of the brass.

A similar effect has been found in zinc; for example, 'Tadanac' zinc, which would contain about 0·006 per cent lead, polished for 5 min. at 2·5 volts in orthophosphoric acid of specific gravity 1·375. The particles outline the original as-cast grain boundary. 'Crown Special' zinc polished under the same conditions showed considerably fewer particles corresponding to its lower lead content of 0·002–0·003 per cent. No subsequent polish at a reduced voltage was necessary to obtain ringed particles in zinc specimens, but polishing at a higher voltage tended to eliminate the ring effect. This is in accord with the greater potential to be expected between lead and zinc compared with lead and brass.

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Ministry of Supply,
July 27.

Alpha-Gamma Transformation in Iron-Carbon Alloys

THERE are many indications that the gamma modification of iron-carbon alloys, existing above the temperatures indicated by the lines GS and SE in the iron-carbon diagram[1], should be regarded as heterogeneous and not homogeneous as heretofore.

Experiments based on microscopic and X-ray analysis of quenched hypo- and hyper-eutectoid alloys have provided evidence of the existence of three distinct austenitic pseudo-phases, which may be called γG, γS and γE to correspond to the composition given by points G, S and E, namely, nil, 0·8882 per cent and 1·7764 per cent carbon[2].

In carbon-free iron the austenite is γG only. In hypo-eutectoid steels the austenite grains are of γS composition intersected with plates and needles of γG austenite, the amount of which increases as the composition approaches that of point G. In hyper-eutectoid steels the austenite is γS intersected with plates and needles of γE austenite, the latter increasing in quantity as the composition approaches that of point E.

The composition of all three austenitic pseudo-phases, γG, γS and γE, is stable and corresponds to pure, face-centred cubic iron, one carbon atom associated with six face-centred cubic iron unit cells (24 iron atoms), and one carbon atom associated with three face-centred cubic iron unit cells (12 iron atoms) respectively. When quenched, γG austenite produces ferrite, γS austenite produces martensite, and γE austenite produces retained austenite.

Experiments with various iron-carbon alloys quenched in various ways tend to show that the amounts of ferrite, martensite and retained austenite obtained in the quenched specimen are independent of the quenching-rate so long as a certain critical rate (not determined) is exceeded.

A more detailed discussion of some of the questions which emerge from the above hypothesis will be published in due course.

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July 22.

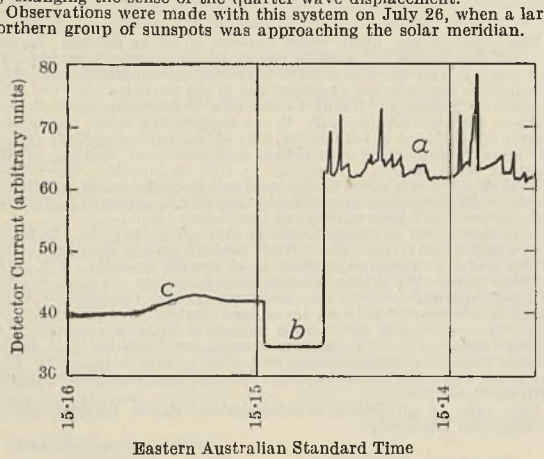
[1] Desch, C. H., "Metallography" (London: Longmans, Green, 1944).
[2] Wrazej, W. J., *J. Iron and Steel Inst.*, No. II, p. 189*P* (1945).

Polarization of Solar Radio-frequency Emissions

THE recent experimental proof[1] that the sun emits energy on radio frequencies was followed by evidence[2] that the amount of such energy can increase markedly during the passage of important sunspots across the solar disk. Such sunspots are invariably associated with strong magnetic fields, the influence of which almost certainly extends into the upper chromosphere and inner corona. Considerations of optical depth indicate that the observed emissions cannot come from below these levels, so that they must arise in regions where the electron collision frequency is much less than the (radio) wave-frequency, and where the latter is probably of the same order of magnitude as the gyromagnetic frequency He/m. Under these conditions we should expect to find evidence of the magnetic field in the production of gyratory effects at the source of the emissions, and/or in differential absorption of right-handed and left-handed components of polarization during transmission through the corona.

An opportunity occurred of testing this hypothesis during the passage of a large sunspot group across the solar disk in the last week of July 1946. The observations were made on a frequency of 200 Mc./s. with an aerial system which was so disposed as to receive circularly polarized radiation of one sense only (right- or left-handed). This was achieved by the use of four Yagi aerial arrays, of which one set of two was disposed perpendicularly to the other set. In addition, one set was displaced by a quarter of a wave-length from the other, in the line of sight. It is not difficult to show that the output voltage from such a system is zero for circularly polarized radiation of one sense and has the full value appropriate to the field strength for the other sense. It is easy to change the sense of the polarization accepted by changing the sense of the quarter wave displacement.

Observations were made with this system on July 26, when a large northern group of sunspots was approaching the solar meridian. It was found that the right-handed circularly polarized power received was some seven times greater than that received when the system accepted only left-handed circularly polarized radiation. A portion of the record obtained at this time is shown herewith. It will be noticed also that there is an absence of sudden short bursts on the left-handed system. Three days later, when this spot group had crossed the meridian, these conditions were reversed, five times more power being then received on the left-handed than on the right-handed system.



SOLAR NOISE RECEIVED AT CANBERRA, JULY 26, 1946
(*a*) Circular right-handed polarization, (*b*) aerials directed away from sun, (*c*) circular left-handed polarization.

It would appear, therefore, that the magnetic field of sunspots, and probably the inclination of this field to the line of sight, profoundly affect the radiations observed. For this spot group the main field was inclined towards the earth before crossing, and away from the earth after crossing, the solar meridian. Making a solar application of Appleton's magneto-ionic theory of the ionosphere, we may say that our results correspond, in both cases, to the 'extraordinary' ray being stronger than the 'ordinary'.

This work is being carried out on behalf of the Council for Scientific and Industrial Research.

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Canberra.
Aug. 6.

[1] Southworth, *J. Franklin Inst.*, 239, 285 (1945).
[2] Pawsey, Payne, Scott and McReady, *Nature*, 157, 158 (1946).

A Theorem in Statistical Mechanics

STATISTICAL mechanics considers any particular body at given temperature T as a member of a canonical ensemble, that is, the probability of finding it with energy E is given by

$$P \propto \Omega \exp -E/kT,$$

where Ω is the multiplicity of the level E of this body. We can take it that, for the body under test, P is a maximum with regard to any parameter n so that

$$\frac{\partial \log P}{\partial n} = 0 = \frac{\partial \log \Omega}{\partial n} - \frac{1}{kT}\frac{\partial E}{\partial n}.$$

The use of this relation

$$\frac{\partial \log \Omega}{\partial n} = \frac{1}{kT}\frac{\partial E}{\partial n} \quad . \quad . \quad (1)$$

appears to simplify appreciably the treatment of some problems in statistical mechanics. I have not, however, been able to find it mentioned anywhere in the known treatises on the subject.

For example, let a monatomic crystal be given with n holes (Schottky defects). Let each hole contribute an energy ε so that $\partial E/\partial n = \varepsilon$. The multiplicity associated with n holes comes to $(N+n)!/N!\,n!$, where N is the number of atoms in the crystal. The relation (1) yields at once $n = N \exp -\varepsilon/kT$. Expressions for combined Schottky and Frenkel defects are derived in the same way. A second example of the application of (1) is provided by the order-disorder transformation of alloys in the Bragg–Williams approximation. For β brass, for example (following substantially the terminology of Fowler and Guggenheim), an order parameter s is introduced so that for a crystal consisting of $N/2$ each of copper and zinc atoms, the number of zinc atoms occupying zinc sites and also the number of copper atoms occupying copper sites is given by $(1+s)N/4$, and the number of zinc atoms occupying copper sites and also the number of copper atoms occupying zinc sites is given by $(1-s)N/4$. It is readily seen that the number of states for a given s comes to

$$\Omega = \left[\frac{(N/2)!}{\{(1+s)N/4\}!\,\{(1-s)N/4\}!}\right]^2 \quad . \quad (2)$$

Associating an energy $-2\chi_{ZnCu}/z$, $-2\chi_{ZnZn}/z$, $-2\chi_{CuCu}/z$ with each link ZnCu, ZnZn, CuCu, where z is the number of nearest neighbours to each atom, and noting that the probable number of these links is given by $(1+s^2)Nz/4$, $(1-s^2)Nz/8$, $(1-s^2)Nz/8$, we can write down the energy associated with the value s of the order parameter

$$E = -\frac{N}{2}\left(\{1+s^2\}\chi_{ZnCu} + \tfrac{1}{2}\{1-s^2\}\{\chi_{CuCu}+\chi_{ZnZn}\}\right). \quad (3)$$

Hence,

$$\frac{\partial \log \Omega}{\partial s} = \frac{N}{2}\log\left(\frac{1-s}{1+s}\right)$$

and

$$\frac{\partial E}{\partial s} = -\frac{sNw}{2}, \text{ with } w = 2\chi_{CuZn} - \chi_{CuCu} - \chi_{ZnZn}$$

The relation (1) then leads at once to the basic equation

$$\log\frac{1+s}{1-s} = \frac{sw}{kT} \quad . \quad . \quad (4)$$

without the use of any more of the apparatus of thermodynamics or statistical mechanics.

It should be mentioned that the relation (1) follows also from the frequently used identification $S = k \log \Omega$ by minimizing the free energy $F = E - TS$, but there the conceptual implications are far less obvious than its connexion with the canonical ensemble.

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Quantization of the Solar System and its Consequences

In an earlier communication[1] I pointed out that our solar system is quantizable according to the equation:

$$n \times 137^k = \frac{\text{orbital impulse}}{2 \times \text{planetary spin}},$$

Closer scrutiny of the table published there leads to the conclusion that the planets occupy the places of the lowest quantum numbers at their disposal in the order of their sizes. This might be expected: their density and time of revolution can only take values within comparatively narrow limits, and accordingly the quantum number of a planet is approximately inversely proportional to the square of its radius. In the case of each planet the following data can be considered as *a priori* given: its mass, and accordingly, roughly speaking, its extension; its kinetic energy and so its orbital impulse; and lastly the direction of its revolution. While the planets cool down and contract, the proportion between centrifugal force and force of gravitation will undergo a change on their surface. If the maintenance of the kinetic energy of revolution alone were to be considered, the centrifugal force would decrease proportionally with decreasing radius of the planet compared to the force of gravitation. With the decrease of the planetary spin, however, the quantum number would continuously grow. This would be in contradiction to the basic law of quantization. The fact that the places of the lowest quantum numbers are evidently all occupied—and have remained occupied from the beginning—is also against this supposition.

The only remaining solution is that as the planet cools down the quantum number, that is the planetary spin, remains constant, while the kinetic energy of revolution of the planet increases at the expense of its far greater orbital energy. In this case, however (if one neglects the slight changes in orbital impulse), with the decrease of the radius of the planet, the centrifugal force will grow compared to the gravitational force. This leads in time to the loss of the planet's stability. The earth, for example, for reasons of stability could only fill a place in the group $k = 2$ if its density were at least six orders smaller than its present value.

It is interesting, therefore, to examine the stability of a hypothetical planet the mass and speed of which are identical with the total mass and mean speed of the planetoids situated between Jupiter and Mars. The total mass of the planetoids is only 1/800 of the mass of the earth, and so this planet could get—even if its density at its formation was far smaller than the density of Saturn—into the group $k = 3$. As the smallest planet of this group, of the places of low quantum numbers at its disposal, this planet will occupy the highest one, $n = 6$. As in cooling down the density of the planet reached that of Saturn, the centrifugal force at its equator would become equal to the gravitational force, and at the grade of density corresponding to that of Mars it would become double the gravitational force. From its extraordinary smallness it follows that the cooling down of the planet became higher than this, and accordingly it exploded.

Investigations regarding the galactic system render plausible the assumption that our Milky Way is a system in equilibrium in the sense that its stars revolve on Kepplerian orbits around its centre. In the case of our sun, the Planck constant. determining the quantization of its orbit, can be computed from the total impulse of the solar system, $h/2\pi = 3{\cdot}21 \times 10^{50}$. The mass of the solar system is $2{\cdot}00 \times 10^{33}$ gm.; the measurements of its speed give in relation to the globular clusters 275 ± 50 km./sec., to the extragalatic systems 380 ± 110 km./sec. The weighted mean is 304 ± 53 km./sec. The distance of the centre of the galactic system is, from the measurements of Plaskett and Pierls, $10{,}000 \pm 2{,}000$ parsecs; accordingly the orbital impulse of our solar system is $(1{\cdot}88 \pm 0{\cdot}50) \times 10^{65}$ cgs., giving for $k = 6$ the value $n = 0{\cdot}9 \pm 0{\cdot}2 \sim 1$.

The time of revolution of the Milky Way, at the place of the solar system, computed from the shift of the maximum of the Compton–Getting effect of cosmic radiation is 234 ± 10 million years[2]. Using this value, if $n = 1$, the speed of the solar system is 301 ± 13 km./sec., the distance of the centre of the Milky Way $11{,}400 \pm 500$ parsecs and the total mass of our galaxy 4×10^{44} gm. It is remarkable that cosmic radiation measurements seem to furnish more exact data than astronomical measurements alone.

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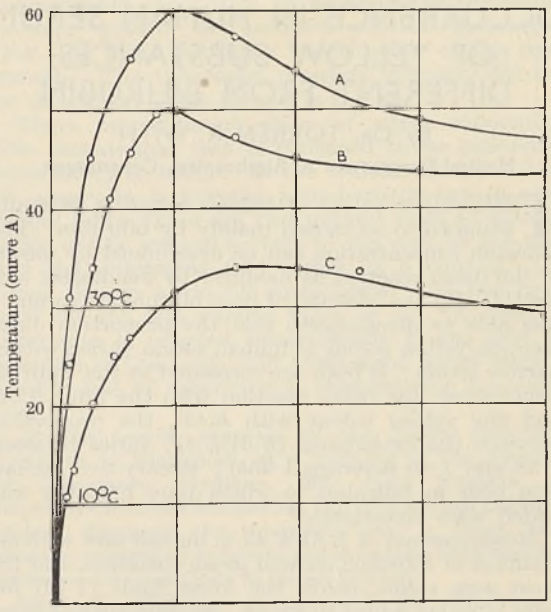
Thermal Inductance

Introduction. The concept of heat flow under a thermal driving force or temperature difference with the applied analogy to the flow of electric charge under an e.m.f. has given rise to the well-known concept of thermal resistance, which has been made the basis of a model method of studying heat-flow problems by the construction of equivalent electrical circuits. Proposed by Langmuir, Adams and Meikle[1] this method has been developed by Beukin[2] and by Paschkis[3], to deal with transients as well as steady-state heat flow. Since, as these authors claim, oscillatory phenomena are not observed in heat-flow problems, the thermal circuits are non-inductive and may be represented by electrical models consisting of resistances and capacities.

The claim that heat flow is non-inductive in nature cannot, however, be upheld in fluid systems. A heated body in a fluid sets up a system of convection currents possessing kinetic energy. In virtue of this kinetic energy, the associated heat flow has the property of inertia; so that if the temperature difference driving the convection current is suddenly changed, we must expect a certain lag before the heat-flow rate settles down to the value appropriate to the new driving force. By analogy with the magnetic field surrounding an electric current, we may take the thermal inductance of the fluid system as proportional to the kinetic energy stored in the 'natural convection field'.



Experimental. Neglecting for the moment the inertia of the convection current, the electric circuit equivalent to the heat flow from a horizontal cylinder immersed in a fluid must consist of a resistance with a distributed capacity representing the thermal capacity of the fluid. The experimental operation consists in suddenly applying heat at a steady and measured rate to the cylinder and measuring the temperature difference between the surface and the bulk of the fluid. In the electrical model the equivalent operation consists in suddenly drawing a steady current and measuring the change in the potential difference. For a network of capacities and resistances, the potential difference will gradually build up to the final steady value. For circuits involving sufficient inductance on the other hand, the initial potential difference may be higher than the final potential difference, which is approached asymptotically from above.

The experimental set-up used to examine the nature of these thermal transients was based on the hot wire device already described[4]. The heated cylinder becomes a short length of resistance wire (26 gauge S.W.G.) to the centre of which was welded a still finer thermocouple of nichrome-constantan. One junction of the couple was attached to the heated wire and the other placed in the liquid about 0·5 cm. horizontally from the hot wire. The heating current was a measure of the rate of heat input, and the thermocouple e.m.f. a measure of the resultant temperature difference.

The hot wire device was immersed in various test fluids and at a stated time a predetermined heating current was suddenly switched on. The e.m.f. of the thermocouple was measured at intervals of ten seconds until final steady values were obtained. Two to ten minutes were required for the temperature difference to settle down to a steady value, the time varying both with the liquid and with the heating current used. In all cases there was an initial rapid rise from zero temperature-difference attributable to the finite thermal capacity of the hot wire itself. The fluids studied included water, various sucrose solutions and hydrocarbon oils covering a wide range of convection moduli. The hot wire was used at various temperatures from about 1° C. above the temperature of the fluid to a few degrees below the boiling point of the liquid concerned. In all examples except those involving very slight temperature differences, the temperature difference – time curve passes through a maximum, and the temperature difference approaches its final value from above.

A few typical temperature difference – time curves for constant heat flow are given in the accompanying graph. Curve A refers to the results obtained with a 70 per cent sucrose solution and wire heated with 1·21 amp. The maximum temperature attained by the wire was 60° C. above the surroundings, the final temperature 47° C. above the surroundings. Curves B and C refer to 40 per cent sucrose solutions; curve B to a heating current of 0·400 amp. (maximum temperature rise 5·0° C., final 4·3° C.) and curve C to 0·305 amp. (maximum temperature rise 3·4° C., final 2·8° C.). Transients of the nature shown by these three curves could not be the product of non-inductive circuits.

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OCCURRENCE IN HUMAN SERUM OF YELLOW SUBSTANCES DIFFERENT FROM BILIRUBIN

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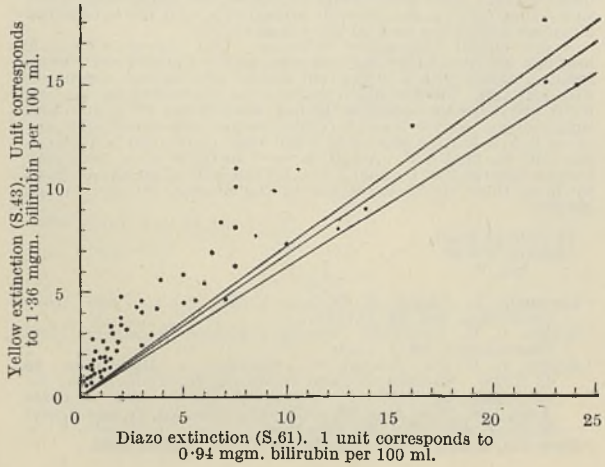
THE yellow colour of human serum is generally assumed to be caused mainly by bilirubin. The bilirubin concentration can be determined by means of the diazo reaction as modified by Jendrassik and Gróf[1,2]. By the addition of pure bilirubin to serum, I was able to demonstrate that the proportion diazo reaction/yellow colour in human serum varied within narrow limits; if both are measured in the Pulfrich photometer, the diazo reaction with the filter *S*.61[1] and the yellow colour with *S*.43[3], the proportion between the extinctions (*E*.61/*E*.43) varies between 1·38 and 1·60 (average 1·455); twenty-five human sera poor in bilirubin to which pure bilirubin was added were investigated[4].

Measurements of *E*.61/*E*.43 in human sera without addition of bilirubin showed great variation, and for most sera values below the lower limit (1·38) for pure bilirubin added to serum. My measurements on twenty-eight normal and thirty-one icteric sera are presented in the accompanying diagram, in which three lines are drawn corresponding to the limits and average (1·38, 1·60 and 1·455) of the proportion *E*.61/*E*.43 for bilirubin added to serum. The diagram shows that most of the sera have considerably more yellow colour than that corresponding to their diazo reaction. This may be due to the presence of yellow substances other than bilirubin, or to partial reaction only of their bilirubin with the diazo reagent; but with the technique used the latter cannot be true[4], and consequently yellow substances different from bilirubin (yellow non-bilirubin) must be present.

A quantitative expression of the yellow non-bilirubin content of a serum may be obtained from the diagram by drawing a vertical line through the point corresponding to the serum in question (defined by its diazo and yellow extinctions). The distance from this point to the point of intersection between the vertical line and the line in the diagram symbolizing the average value of *E*.61/*E*.43 corresponds to the yellow non-bilirubin extinction, and the distance from the point of intersection of the vertical line and the *E*.61/*E*.43 line to the point of intersection of the vertical line and the abscissa corresponds to the yellow extinction of the bilirubin present in the serum. The yellow units of the diagram correspond to 1·36 mgm. bilirubin each. From the diagram it is seen that in most normal sera (diazo extinction less than 2) the yellow non-bilirubin extinction is considerably greater than the yellow bilirubin extinction, and in some icteric sera also this is the case.



The chemical nature of the yellow non-bilirubin is not sufficiently known. The carotenoids have to be taken into account, but as the total serum carotenoids —measured as β-carotene—in European populations show concentrations only as low as 10–50γ—and seldom above 100γ—per 100 ml. serum[5,6,7], it can be calculated that their extinction with *S*.43 in most cases is less than 0·1 of our yellow extinction units[3], and as the yellow non-bilirubin concentration most often is greater than 0·5 yellow units (cf. the diagram) the carotenoids can only form a minor part of the yellow non-bilirubin and in most cases an insignificant one.

For biliverdin it is known that its absorption at 660 mμ is three to six times that at 430 mμ, varying with the solvent[8]. The 660-extinction of fifteen normal and ten icteric sera was measured with filter *S*.66 in the Pulfrich photometer and compared with their yellow non-bilirubin extinction, and the fraction *E*.66/*E*.43 varied between 0·07 and 1·10 (average 0·325); as biliverdin shows the value 3–6 for this fraction, only a small part of the yellow non-bilirubin can consist of biliverdin.

Other substances which may form a part of the yellow non-bilirubin are the pyrrol compounds bilifuscin and mesobilifuscin[9,10], which are formed from myoglobin by a process parallel to the formation of bilirubin from hæmoglobin, and according to Engel[11] are also formed during the normal disintegration of hæmoglobin. Further, the so-called xanthorubin, a yellow compound present in the serum of hepatectomized dogs in greater concentration than bilirubin itself[12,13,14], should be considered in this connexion.

As strongly icteric sera generally show yellow non-bilirubin extinctions producing only small fractions of their bilirubin extinctions (cf. diagram), it may be concluded that the elimination of yellow non-bilirubin from the organism must take place chiefly by other means than the liver and bile; further, as the serum in uræmia is not more yellow-coloured than normal serum, the kidneys cannot play any part in its elimination.

The isolation of yellow non-bilirubin for further study will be a difficult task, as its concentration in the serum at the most amounts to *c*.6 extinction units, corresponding to *c*.8 mgm. bilirubin per 100 ml. of serum.

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ERADICATION OF TUBERCULOSIS IN CATTLE

IN the course of the last half-century, much has been written on the danger to the human population of the existence of tuberculosis in cattle. There have been strong demands for the elimination of the disease from cattle in Britain, and inevitably opposition to this policy has been roused, on the ground of the magnitude of the task from the economic aspect; the danger of damaging the milk supply of the nation because of the large proportion of milch cows that are tuberculous; the desirability of maintaining infection with tuberculosis in order that the milk of the nation may be infected, so that those consuming it may acquire immunity and withstand the ordinary risks of infection from contact with people suffering from the disease; from a belief that pasteurization destroys a food factor not easily replaceable, and essential for those who depend largely or entirely on a milk diet; and by some because of a mystical belief that animals should be maintained according to what are spoken of vaguely as 'natural' methods.

A great deal of factual information is now available, and experience in other countries strengthens the case of those who favour action to remove a serious source of ill-health in the most important class of livestock in Britain. To-day it can be asserted with confidence that the important agricultural interests are to the fore in the demand for means to get rid of the disease. On many of the questions which were controversial only a few years ago, there is now general agreement.

The history of efforts to control the disease in cattle in all countries is that individual voluntary effort fails to yield results of any considerable value. To attain results which are worth while, operations have to be carried out through the agency of well-organised government departments, supported by certain powers conferred by legislative action, with the co-operation of the industries concerned and under conditions that enable financial aid on a suitable scale to be given to compensate for the special measures required from the owner, until success has been achieved. A primary factor in the organisation for ridding cattle of the disease is the possession of a sufficiently reliable and convenient means of detecting the affected animals. This is provided by the tuberculin test. There are, however, differences of opinion about the most suitable type of tuberculin and the manner in which it should be used.

In the United States of America, an intense nation-wide campaign was carried out by combined Federal and State veterinary departments from 1917, when it was considered that 6–8 per cent of all American cattle were infected, until 1940, when in every county of every State less than one half of one per cent of the cattle were reactors to the tuberculin test and, incidentally, not more than one half of those reactors in 1940 were actually affected with tuberculosis. The tuberculin used in this campaign was prepared from a culture of tubercle bacilli grown on a special nutrient medium consisting entirely of known chemical products and free from proteins. The resultant growth was then concentrated by heating. A more refined type of tuberculin is now available. It is grown similarly on a defined chemical, protein-free culture medium, but it is concentrated chemically, to separate the tuberculin protein, known as 'purified protein derivative' (P.P.D.), from the other constituents of the final growth. The tuberculin prepared officially for use on animals in Great Britain is P.P.D.

There are different ways of using tuberculin. The intradermal test is conceded to be eminently satisfactory in cattle. In the United States, a dose of tuberculin is injected intradermally into a subcaudal fold; there are two natural folds of skin in cattle at the ventral surface of the root of the tail, and the uninjected fold serves as a control. In Great Britain a 'double intradermal' test has been used for the last twenty years or so. A dose of tuberculin is injected intradermally in the skin at one side of the neck, and forty-eight hours later a second dose of tuberculin is injected into the same site.

At the recent congress of the Royal Sanitary Institute at Blackpool, at a meeting of the Section of Veterinary Hygiene, Mr. John Francis, of Imperial Chemical Industries, Ltd. (Biological Laboratories), discussed the tuberculin test in detail and also the control of tuberculosis in cattle, with special reference to conditions in Great Britain.

Prof. T. Dalling, director of the Veterinary Laboratory, Ministry of Agriculture, described work on the disease in progress in Great Britain. He emphasized that, in addition to the great danger to human beings from tuberculosis in cattle, the economic loss sustained by the farming industry and by the State, on account of the extent of the disease in our cattle, is also very important. There is clear evidence that herds free from the disease have a very much higher standard of health than infected herds. When young stock in affected herds are kept apart from the adult cattle, and are not given infected milk, the tuberculosis-rate in them is low. Incidentally, cattle can acquire the disease from contact with infected human beings.

Tests of the usefulness of the vaccination of cattle against the disease have been in progress for some years. Results of some value have been obtained, and it is possible that in certain circumstances vaccination may play a part in control operations. For some years farmers have been encouraged to eliminate the disease through the government Attested Herd and Tuberculin Tested Herd schemes, and a good deal of progress has been made, in that a large number of herds are now so dealt with.

Prof. Dalling explained that investigations of the value of the different types of intradermal tuberculin tests are in progress, and that if a simpler test than the one hitherto used in Great Britain is found to be satisfactory, it will be given consideration by those responsible for policy.

The following resolution was passed at the meeting: "That this section is of the opinion that the Government, in its post-war plans for increasing the efficiency of agriculture and so improving public health, should give high priority to the eradication of bovine tuberculosis".

Closely bound up with the tuberculosis problem, but concerned also with other diseases that affect mankind, is the general question of a safe milk supply. Recent developments are discussed in an article in the *Lancet* of March 2. Among the matters referred to are the pasteurization controversy; the monetary value of the losses due to tuberculosis in cattle (£20–£30 million a year); the marking of cattle that are reactors to the tuberculin test; the

inoculation of calves against bovine brucellosis (contagious abortion); financial assistance required by farmers to help them to free their herds from tuberculosis; the provision of a free State veterinary service; the establishment of a system of eradicating tuberculosis by producing disease-free areas, which would be gradually extended; the provision of a State abattoir service under veterinary supervision, to ensure that the meat supply is sound and, incidentally, to serve as a guide to the incidence of the important diseases of cattle; the need for adequate water supplies on farms and, on a great many farms, for improved buildings.

The article deals with many aspects of the subject and shows in what directions developments are required; and it is to be hoped that, before long, it will be possible to embark on a new stage of the campaign against disease in dairy cattle. What many would like to see would be the first stages of an 'area plan'.

THE SIGNIFICANCE OF SCIENCE FOR INDIA

THE annual address by the president to the Royal Asiatic Society of Bengal is often of much interest to men of science, and that delivered by Prof. M. N. Saha last February is no exception. The earlier part of the address is directed, as is customary, to the affairs of the Society. Prof. Saha mentions the celebrations in January of this year of the bicentenary of the birth of Sir William Jones, the founder of the Asiatick Society in 1784. He records with pleasure the presence at this celebration of delegates from Iran and Afghanistan, and of the writer of this note as the representative of the Royal Society of London. There is no doubt that much good results from such visits and personal contacts, and that scientific workers in their intercourse with those of other countries do much to promote the friendship that is indifferent to, and often cuts across, political trends. When international congresses in science, and other learned activities of man, can be resumed without let and hindrance due to considerations of finance, rationing and politics, the world will be further on the path to peace than appears at present to be the case.

Prof. Saha directs attention, as has often been done before, to the magnificent collection of Sanskrit, Persian and Arabic manuscripts, numbering some fifty thousand, held in trust by the Society for the public. He records the grant by the Government of Bengal of four research fellowships for Sanskrit and Islamic studies and for research in epigraphy and numismatics. A need of the Society that grows more pressing yearly is for new and more commodious premises to replace the beautiful but now structurally unsound building (137 years old) in which the Society is housed at 1 Park Street, Calcutta. Application for financial aid has been made both to the Government of India and to the Government of Bengal. Lord Wavell has himself shown sympathy in this matter.

The main portion of Prof. Saha's address is of unusual interest, because during his period as president he was also a member of the Indian Scientific Mission that visited the United Kingdom and the United States during 1944–45. Later, in 1945, Saha visited the U.S.S.R. as the Indian delegate on the occasion of the 220th anniversary celebrations of the Academy of Sciences of the U.S.S.R. These visits were all made by air. In his address, Prof. Saha is able to discuss in turn scientific activities in Great Britain, the United States and the U.S.S.R., and he speaks with admiration of the work done in each of these three countries during the War. With reference to Great Britain he writes: "Science has saved Britain and led to victory". He summarizes the views of Sir John Anderson and Prof. A. V. Hill that the progress of science and of its application to public welfare depends on the four M's: "Men, money, material, and machinery or organisation", and thinks that Britain will never again allow science to be neglected in her home country. He continues: "Can this be said of India? As far as my knowledge goes, neither Prof. Hill's valuable report, nor the resolution of the National Institute of Sciences that one per cent of the central and provincial budget should be set aside for scientific research, nor the measures of taxation relief in the case of endowments for scientific researches proposed by no less a person than the late Finance Member Sir Jeremy Raisman himself, has yet been considered seriously by the Government of India."

Among many interesting remarks on the development of the United States, Prof. Saha draws a lesson from California: "The people must have the genius to develop the resources with which Nature has bountifully endowed almost every major country. This was nowhere more apparent to us than in the State of California, which, with its green orchards, fertile fields and clear sky reminded us strongly of our own Bengal. We thought that the rainfall must have been as heavy as in Bengal otherwise the country could not be so green and productive. On enquiry we found that the average precipitation was no larger than 16 inches, almost the same as we find in the desert parts of the southern Punjab. Whence comes the life-giving water which nourishes the fields of California?"

The answer is that California is irrigated by water brought some three hundred miles from the Colorado River through an aqueduct. This enterprise and the harnessing of other rivers in America for the development of power leads Prof. Saha to eulogize President Roosevelt for his part in promoting the New Deal in America, and in overcoming the reluctance of the separate States to grant facilities for such projects as the Tennessee Valley Authority.

On his journey to the U.S.S.R., Prof. Saha visited Bahrein and crossed Arabia by air, and this led him to mention the great oil discoveries that have been made in Arabia and the U.S.S.R. as a result of geophysical research, and the necessity of employing such methods in India (the Burmah Oil Co. Ltd. has, of course, been doing this for years). He also records how in the U.S.S.R. the Academy of Sciences has, during the last twenty-five years, been invested with wide administrative powers, with a budget equivalent to nearly 10 crores of rupees (£7,500,000), managing seventy-six research institutions and a number of scientific commissions: in fact, the Academy is the mainspring of scientific life in the U.S.S.R.

Prof. Saha summarizes his conclusions as follows: "Old national boundaries have vanished, and the new age will be one of 'Super States'. Little States cannot survive either politically or economically. The U.S.A. has achieved this position earlier than all other nations because: (*a*) one hundred and seventy years ago it won the fight to work out its own destiny;

(*b*) it gave every man the opportunity to develop his own personality, and neither religion nor ethnic origin was any bar [Prof. Saha has overlooked the fact that though this is so constitutionally, yet in practice there is the Negro problem] ; (*c*) the people had the genius to develop the resources of the country, using the latest discoveries in science and technology ; (*d*) there has been a great administrative centre for the whole country, which did not allow any constituent State to secede, or interfere with internal development. Should not we in India remember these great lessons on the eve of our impending political changes ?"

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ULTRA-MICRO METHODS IN NUCLEAR CHEMISTRY

G. T. SEABORG has again added to the general knowledge of the trans-uranic elements by his introductory remarks to a meeting of the American Chemical Society and his lecture there on "The Impact of Nuclear Chemistry"[1]. According to the rather tentative definition with which Seaborg prefaces his introductory address, "nuclear chemistry should be defined as embracing the chemical aspects of the study and application of nuclear reactions, the investigation of radio-chemistry, and the application of radio-active isotopes and nuclear methods to the study of chemical problems in general".

The interest of the paper centres in Seaborg's description of the ultra-microchemical methods used in the investigation of the trans-uranic elements. Immediately after the discovery of the first isotopes of neptunium and plutonium, namely, Np 239 (May, 1940), Np 238 and Pu 238 (late in 1940), Pu 239 (spring, 1941) and Np 237 (early in 1942), their chemical properties could be studied only by tracer methods on carriers provided by elements of lower atomic number. However, as it was intended to work out at that early stage the process to be used for the large-scale extraction of plutonium once the piles were working, it was most desirable to test the methods in advance with visible and weighable amounts of material. Therefore, microgram quantities of plutonium and neptunium were produced by prolonged irradiation of uranium with cyclotrons ; in order to get concentrations comparable to those in the technical application, the reactions were performed in minute amounts of solution (10^{-1}–10^{-5} c.c.). These are handled with the help of capillary containers, pipettes and burettes. Liquid volumes are measured in calibrated capillary tubing, the movement of the liquid within the capillary being governed by air pressure under sensitive control. The smaller pipettes may be built to fill automatically by capillary attraction. The test-tubes and beakers for this work are made out of capillary tubing with an inside diameter of 0·1–1 mm. The weights of solids handled amount to about 0·1–100 micrograms ; a precision of 0·5 per cent is easily reached. Levels are observed under the microscope. Pipettes, etc., are worked with micro-manipulators. Liquids are usually separated from solids by centrifugation rather than filtration.

For weighings, the Salvioni balance is often employed. This has a pan supported by a horizontal quartz fibre, which bends when weights are applied. As an alternative, a balance was developed in the University of California with which 1 μgm. or less, in a container of up to 25 mgm., can be weighed with an accuracy of 2 per cent. In this balance, a beam, to which the two pans are fixed, is supported at right angles to the plane of the beam by a horizontal quartz fibre. When the beam is depressed on one side under a load, it is restored to the initial horizontal position by twisting the supporting quartz fibre. The twist needed is a measure of the load.

Up to 1943, altogether about 1,000 μgm. plutonium (239) were produced in cyclotrons. Not only were reactions in the liquid phase investigated, but also dry reactions, and even the properties of the metal itself. Smaller, but still weighable, quantities of neptunium were also made. In this case, the isotope Np 237 was used, being the only known isotope of neptunium of long half-life ($2{\cdot}25 \times 10^6$ years). This is the daughter of the β-active U 237 formed by the U 238 (*n*, 2*n*) U 237 reaction. As the latter process is highly endothermic and, therefore, needs fast neutrons, yields are much smaller. Nowadays, of course, Np 237 as well as Pu 239 are made in the piles in quantities sufficient for the application of ordinary chemical methods[2].

Seaborg's researches on elements 95 and 96 have been referred to before[2]. He has now named the two elements 'americium' and 'curium'. The name 'americium', given to the element with six 5*f* electrons, is in analogy to the name 'europium' of the element with six 4*f* electrons. The name 'curium' for the element with seven 5*f* electrons, recalling the pioneers of radioactivity, corresponds to the name 'gadolinium', given to the element with seven 4*f* electrons in honour of the pioneer of the investigation of the rare earths.

It is expected by Seaborg that the starting of the new 184-in. cyclotron in Berkeley will give a new impetus to nuclear chemistry. Employing particles of up to 400 MeV. energy, far-reaching destruction even of lighter nuclei with the emission of showers of protons and neutrons as well as new types of fission are anticipated, leading to new families of radioactive isotopes.

E. BRODA

[1] *Chem. and Eng. News* (May 10, 1946), 1192.
[2] *Nature*, 157, 307 (1946).

IDENTIFICATION OF THE CORONAL LINES

PROF. BENGT EDLÉN delivered the George Darwin Lecture of the Royal Astronomical Society on October 12, 1945, taking as his subject, "The Identification of the Coronal Lines". As a net result of all observations of the coronal line spectrum, the wave-lengths of about twenty coronal emission lines have been established. Six outstanding lines are due to iron, namely, λλ3388, 5303, 6374, 7892, 10747 and 10798. No coronal lines have been observed in a laboratory source of light, and coronal lines were a unique feature of the solar corona until 1932, when a number of them were observed in the spectrum of the recurrent nova *RS* Ophiuchi. Coronal lines reappeared in Nova Ophiuchi at the 1942 outburst and were also observed in 1945 in *T* Pyxidis.

The evidence regarding the nature of 'coronium' is carefully examined, and as a result the conclusion

is reached that the essential part of the coronal lines is due to iron, nickel, calcium and argon atoms deprived of about half their normal electron envelope. Such a high state of ionization raises certain problems in solar phenomena, and various attempts have been made to give a physical explanation to established facts.

The existence of a high temperature in the corona is supported by a number of arguments, among which may be noticed the following, all of which point to a temperature exceeding a quarter of a million degrees : (1) the mean high state of ionization as revealed by the emission lines ; (2) the breadth of the emission lines, if this is due to thermal Doppler effect, though macroscopic irregular motions or radial motions of matter might cause the broadening of the lines ; (3) the blurring out of the Fraunhofer lines in the continuous spectrum of the inner corona, assumed to be an effect of the velocities of the scattering electrons ; (4) the absence of the Balmer lines in the emission line spectrum of the corona, explained by the electrons being too fast to be captured by the protons ; (5) dynamical considerations showing that great thermal velocities are necessary to balance the gravitational forces in order to explain the observed density gradient of the corona.

Reference is made to the theory of Alfvén that the corona might consist of particles with very high energy ; Alfvén derived from the density function a temperature of about a million degrees. A quotation is given from Alfvén's work which explains the heating mechanism : "Motion of solar matter in magnetic fields on the sun, especially the vortical motion in a sunspot, must bring about a potential difference between different points of the solar surface, and it was shown that under certain conditions this gives rise to discharges above the surface of the sun. Calculations indicate that the electromotive force can be as high as 10^7 volts, so that even if charged particles are usually accelerated only by a small fraction of this potential, they attain rather high energies. The process is most conspicuous in the prominences, where consequently we can expect a very intense production of high energy particles. As the mechanism is of a very general character the same process is likely to take place very frequently on a smaller scale. If—as many authors mean—we can regard the chromosphere as a multitude of small prominences, it is likely that a production of high energy particles takes place almost anywhere on the solar surface or in some layer above it."

Menzel held a different view of the origin of the highly ionized particles in the corona, and suggested that the coronal matter was ejected from the hot interior of the sun through holes and cracks on the surface. More recently, Vegard has expressed a somewhat similar opinion ; he thinks that the highly ionized heavy ions in the corona come from the sun's deeper layers, being driven away from the sun at high speeds by means of the electric fields resulting from the photo-electric effect produced by soft X-rays. Saha has suggested that the highly ionized atoms emitting the coronal lines are the fragments of a kind of nuclear fission occurring near the surface of the sun.

At present it would be unwise to pronounce in favour of any one of these views, and the physical explanation of the corona still remains a problem.

BROADCASTING IN GREAT BRITAIN

THE British Broadcasting Corporation is at present operating under the terms of a Royal Charter which came into force on January 1, 1937, for a period of ten years (see *Nature*, 139, 19 ; 1937). In view of the approaching expiration of this charter, the Government has given careful consideration to the desirability of appointing an independent body to advise on the organisation of British broadcasting in the future. But it has been decided that such an inquiry would not be appropriate at the present time ; and that the charter and licence granted to the B.B.C. should be renewed, with certain alterations, for a period of five years from January 1, 1947.

The justification for this action is given in a White Paper* recently published. This paper forms a concise historical review of broadcasting in Great Britain, outlining the policy adopted throughout and the development and activities of the Home and Overseas Services up to and including the war years. On the matter of the appropriateness of an inquiry, it is stated that though the Government is not opposed in principle to the appointment of an independent committee, there are three main reasons for not doing this at the present time or even in one year's time. In the first place, since September 1939, the B.B.C. have been operating under completely abnormal conditions ; and the existing charter and licence have therefore run for less than three years under normal conditions ; this is an insufficient period to enable a sound judgment to be made of the merits or otherwise of the organisation established in 1937. Secondly, it is too early yet to see with any clarity the effects on peace-time broadcasting of the remarkable developments in the field of electronics and radio-frequency technique which have taken place during the past ten years. Thirdly, the broadcasting service in Britain must operate with due regard to the allocation of wave-lengths for all radio purposes by the International Telecommunications Union ; and it will inevitably be some time before the existing agreements can be revised to take account of the geographical and technical changes of the past six years.

In renewing the charter and licence for a period of five years, the Government proposes to consider well in advance of the expiry of this period the desirability of appointing an independent committee to advise on future broadcasting. In the meantime, the B.B.C. will continue to provide its service as a public utility body which is ultimately responsible to Parliament, but which is free so far as possible to carry out its obligations without political interference or control. The Postmaster-General is responsible to Parliament for the broadcasting vote, while the Lord President of the Council now deals with all questions of major broadcasting policy.

The White Paper gives details of the distribution before and during the War of the wave-lengths available to Great Britain, and describes the present arrangement of national and regional stations, and the corresponding programmes. A third programme for Home listeners, intended to be received effectively by about 80 per cent of the population, will be introduced by the B.B.C. in the autumn. An obligation has been laid on the Corporation to broadcast a

* Broadcasting Policy. (Cmd. 6852.) Pp. 28. (London : H.M. Stationery Office, 1946.) 6*d*. net.

daily account of the proceedings of Parliament by professional reporters, while at the same time an impartial balance must be maintained between parties in all political broadcasting. The present prohibition of commercially sponsored programmes will be maintained, and the Government intends to take all steps within its power to prevent the direction of commercial broadcasts to Britain from abroad. The Empire Services of the B.B.C. are to be maintained and developed, while in addition, many of the foreign language broadcasts must be continued in support of British prestige and influence abroad. These overseas broadcasting services will, however, be financed by an annual grant-in-aid to the Corporation from public funds, so that the whole of the wireless licence net revenue will be available for the Home services.

In order to meet the cost of the post-war development of sound broadcasting programmes, the weekly duration of which is some 50 per cent above the pre-war level, the Government has recently raised the annual charge for a wireless receiving licence, and introduced an additional charge for the domestic reception of television programmes. Apart from the provision of adequate service time, the Paper states that great importance is attached to improving the technical quality of broadcast transmissions to the public. It may confidently be expected, therefore, that for the next five years the broadcasting service in Great Britain will be maintained and improved, so that it will continue, as in the past, to bear favourable comparison with any other service in the world.

THE ACADEMY OF SCIENCES OF THE U.S.S.R.

THE Academy of Sciences of the U.S.S.R. was founded by Peter the Great on January 22, 1724 (Old Style), but began functioning on November 2, 1725 (Old Style) after Peter's death. Its establishment was part of Peter the Great's scheme of widespread cultural and industrial reforms intended to bring Russia into line with the Western European States. In the draft of the structure and functions of the Academy, Peter was guided by the examples of the Royal Society of London and the Paris Academy of Sciences. In commemoration of the 220th anniversary of its existence the Academy has published a substantial, well printed and handsomely illustrated volume entitled: "220 years of the Academy of Sciences of the U.S.S.R., 1945" (Moscow and Leningrad, Acad. of Sci. U.S.S.R., 1945). It is a pity that the book is published only in Russian, with no English or French version, for it provides detailed and easily accessible information concerning the structure of the Academy and its membership.

The introduction is historical. The original idea of Peter the Great was that the Academy should combine research and teaching activities, and this conception lasted until 1803. At first, as was natural, the Academy had few native workers, and the names of eminent foreigners, such as L. Euler and D. Bernoulli, occupy the field. M. V. Lomonosov (1711–65) opened up the road to a succession of brilliant workers in all branches of knowledge. These included M. V. Ostrogradsky (1801–61), P. L. Chebyshev (1801–94), A. M. Boutlerov (1828–86), N. N. Beketov (1827–1911), B. B. Golizyn (1862–1916), S. F. Oldenburg (1863–1934), A. A. Shachmatov (1864–1920), S. M. Soloviev (1820–79) and many others. But many prominent men of science, such as N. I. Lobachevsky and D. I. Mendeleev, were excluded from the Academy through the influence of the Government.

After the Revolution of 1917 the Academy grew rapidly: 1725, 15 academicians; 1925, 48 academicians; 1945, 142 academicians and 208 corresponding members; and of these, 109 academicians and 137 corresponding members, together with some four thousand senior and junior scientific workers, are serving at the various institutions of the Academy. Before 1917, the Academy had five laboratories and five museums, and worked through fifteen committees. In 1945 it embraced fifty-three scientific institutes, possessed sixteen laboratories, thirty-five research stations, fifteen museums and eleven provincial sections and worked through thirty-one committees. All these dependent institutions are now grouped into eight sections: (1) physics and mathematics, (2) chemistry, (3) geology and geography, (4) biology, (5) technology, (6) history and philosophy, (7) economics and law, (8) literature and philology.

In addition to the large number of books published under its auspices, the Academy is responsible for some forty-four periodical, seventy-one non-periodical and nineteen serial publications, all of which are listed in this jubilee volume, as well as books specifically relating to the Academy, biographical, bibliographical and historical. There is also a brief but comprehensive account of every institute, laboratory, research station, museum, library, affiliated society and provincial section, and a short biographical note on each academician and corresponding member—in all, a magnificent work of reference to an ancient but remarkably vigorous and active society.

S. I. TOMKEIEFF

APPOINTMENTS VACANT

APPLICATIONS are invited for the following appointments on or before the dates mentioned:

LECTURER IN CHEMISTRY, and a LECTURER IN PHYSICS AND MATHEMATICS—The Clerk, Northern Polytechnic, Holloway, London, N.7 (September 7).

ASSISTANT PHYSICIST—The Superintendent, Christie Hospital and Holt Radium Institute, Withington, Manchester 20 (September 7).

ASSISTANT TO THE CITY ANALYST—The Town Clerk, Civic Hall, Leeds, 1, endorsed 'Asst. to the City Analyst' (September 9).

READER IN CIVIL ENGINEERING (with special interests in Hydraulics and Fluid Mechanics)—The Registrar, The University, Manchester 13 (September 9).

ASSISTANT LECTURER AND DEMONSTRATOR (part-time) IN PHYSICS—The Secretary, King's College of Household and Social Science, Campden Hill Road, London, W.8 (September 13).

LECTURER IN PUBLIC HEALTH—The Secretary, The University, Aberdeen (September 14).

LECTURER IN ORGANIC CHEMISTRY, a LECTURER OR ASSISTANT LECTURER IN ZOOLOGY, an ASSISTANT LECTURER IN PHYSICS, an ASSISTANT LECTURER (or LECTURER) IN CHEMISTRY, and a TECHNICIAN FOR THE ZOOLOGY LABORATORY—The Registrar, University College, Southampton (September 14).

LECTURER IN APPLIED MATHEMATICS and LECTURERS IN THE DEPARTMENT OF PHYSICS—The Registrar, The University, Liverpool (September 14).

SENIOR PRINCIPAL SCIENTIFIC OFFICER (Senior Mechanical Development and Design Engineer), a SENIOR PRINCIPAL SCIENTIFIC OFFICER or PRINCIPAL SCIENTIFIC OFFICER (Senior Electrical Design Engineer), and PRINCIPAL SCIENTIFIC OFFICERS (Mechanical Design Engineers), at the Atomic Energy Research Establishment, Harwell, Berks—The Secretary, Civil Service Commission, 6 Burlington Gardens, London, W.1, quoting No. 1613 (September 15).

ASSISTANT LECTURER IN GEOLOGY—The Registrar, The University, Reading (September 16).

CHAIR OF THEORETICAL PHYSICS, tenable at King's College, and a READER IN EXPERIMENTAL PHYSICS—The Academic Registrar, University of London, Senate House, London, W.C.1 (September 16).

ASSISTANT LECTURER IN GEOLOGY—The Registrar, The University, Reading (September 16).

SENIOR ENGINEER, Power Section, Design and Installation Department of the B.B.C., London—The Engineering Establishment Officer, Broadcasting House, London, W.1 (September 18).

HEAD OF THE ENGINEERING DEPARTMENT of the Paddington Technical Institute—The Education Officer (T.1), County Hall, London, S.E.1 (September 21).

COURTAULD CHAIR OF ANIMAL HUSBANDRY, VETERINARY HYGIENE AND DIETETICS—The Principal, Royal Veterinary College and Hospital, London, N.W.1 (September 23).

SUPERINTENDENT OF THE CHEMISTRY DIVISION, a SUPERINTENDENT OF A DIVISION dealing with FLUTTER, AERO ELASTICITY and GENERAL AIRFRAME VIBRATION, and a SUPERINTENDENT OF THE METALLURGY DIVISION, at the Royal Aircraft Establishment, South Farnborough, under the Ministry of Supply—The Secretary, Civil Service Commission, 6 Burlington Gardens, London, W.1, quoting No. 1611 (September 30).

BACTERIOLOGIST (which includes the LECTURESHIP IN BACTERIOLOGY at Glasgow University)—The Secretary, Glasgow Royal Infirmary, 135 Buchanan Street, Glasgow, C.1 (September 30).

PROFESSOR OF NATURAL PHILOSOPHY AND DIRECTOR OF THE PHYSICS RESEARCH LABORATORY in the United College, St. Andrews—The Secretary, The University, St. Andrews (September 30).

LECTURER IN ZOOLOGY in the University of Tasmania—The Agent-General for Tasmania, Australia House, Aldwych, London, W.C.2 (September 30).

LECTURER IN CIVIL ENGINEERING—The Secretary, Queen's University, Belfast (October 1).

LECTURER (woman) IN ZOOLOGY—The Registrar, King's College, Durham (October 12).

PHYSICIAN and LECTURER IN PSYCHOLOGICAL MEDICINE—The House Governor, King's College Hospital, Denmark Hill, London, S.E.5 (October 31).

CONSULTANT by the Government of Iraq for the Irrigation Development Commission to study and advise on problems of reclamation and to undertake soil surveys—The Crown Agents for the Colonies, 4 Millbank, London, S.W.1, quoting M.N.16738.

SCIENTIFIC ADVISER to the British Council in Paris—The Director, Appointments Department, British Council, 3 Hanover Street, London, W.1, endorsed 'Science, Paris'.

JOINT ASSISTANT DIRECTOR (honours graduate in Physics with advanced research experience in thermodynamics, fluid flow and surface action)—The Secretary, Gas Research Board, 1 Grosvenor Place, London, S.W.1.

RESEARCH BIOCHEMIST—The Secretary, Liverpool Heart Hospital Institute of Research for the Prevention of Disease, 117 Grove Street, Liverpool 7.

AREA SUPERVISOR (to live in the Newport, Shropshire area) for the National Milk Testing and Advisory Scheme—The Principal, Harper Adams Agricultural College, Newport, Shropshire.

LABORATORY STEWARD in the Chemistry Department of the Municipal Technical College—The Chief Education Officer, Nelson Square, Bolton.

LABORATORY STEWARD AND TECHNICIAN to take charge of the Physics Workshop—The Headmaster, Liverpool Institute High School, Mount Street, Liverpool 1.

LABORATORY TECHNICIAN (Grade III)—The Secretary, Welsh National School of Medicine, 10 The Parade, Cardiff.

CHEMIST to take responsibility for the environmental side of the work of the Department—The Physician in Charge, Department for Research in Industrial Medicine, London Hospital, Whitechapel, London, E.1.

ASSISTANTS (2, male or female) to assist in research work and to look after insect cultures—The Director, Agricultural Research Council, Unit of Insect Physiology, 34a Storey's Way, Cambridge.

RESEARCH CHEMIST—The Director, Motor Industry Research Association, Great West Road, Brentford, Middx.

SENIOR LABORATORY TECHNICIAN IN THE DEPARTMENT OF BIOCHEMISTRY—The Establishment Officer, University College, Gower Street, London, W.C.1.

LECTURER IN PHYSIOLOGY with ability to teach Anatomy or Chemistry in addition, and a LECTURER IN SOCIAL ADMINISTRATION, in the Department of Hygiene and Public Health, a LECTURER IN PHYSICS, and a LECTURER IN MECHANICAL ENGINEERING—The Clerk to the Governing Body, Battersea Polytechnic, Battersea, London, S.W.11.

LECTURER OF BOTANY, to take classes in Botany to B.Sc. (General) standard and Biology to Intermediate Science standard—The Clerk, Northern Polytechnic, Holloway, London, N.7.

LECTURER IN THE DEPARTMENT OF METALLURGY AND CHEMISTRY, and a LECTURER IN MECHANICAL ENGINEERING, at the Rotherham College of Technology—The Director of Education, Education Offices, Rotherham.

REPORTS and other PUBLICATIONS

(not included in the monthly Books Supplement)

Great Britain and Ireland

Proceedings of the Royal Society of Edinburgh. Section A (Mathematical and Physical Sciences), Vol. 62, Part 2, No. 19: A Theory of Regraduation in General Relativity. By Dr. A. G. Walker. Pp. 164–174. (Edinburgh and London: Oliver and Boyd, 1946.) 1*s.* 9*d.* [253

London Advisory Committee for Rubber Research (Ceylon and Malaya). Report of Conference on Post-War Preparation and Packing of Rubber. Pp. 32. (London: Imperial Institute, 1946.) [283

The Contribution of the Analytical Chemist to the Problem of Protein Structure. By Prof. A. C. Chibnall. (Second Procter Memorial Lecture.) Pp. 20. (Croydon: International Society of Leather Trades' Chemists, 1946.) 2*s.* 6*d.* [283

Report of the Marlborough College Natural History Society for the Year 1945. (No. 94.) Pp. 24. (Marlborough: Marlborough College, 1946.) 1*s.* 6*d.* to Members; 5*s.* to non-Members. [283

The British Welding Industry. Memorandum prepared by the Welding Sections of the British Electrical and Allied Manufacturers' Association. (BEAMA Publication No. 132.) Pp. 28. (London: British Electrical and Allied Manufacturers' Association, 1946.) Free. [34

Wool Industries Research Association. Publication 179: Report of the Director of Research for 1945. Pp. 28. (Leeds: Wool Industries Research Association, 1946.) [44

Imperial Bureau of Pastures and Forage Crops. Bulletin 35: The Forage Resources of Latin America—El Salvador. By James M. Watkins. Pp. 24. (Aberystwyth: Imperial Bureau of Pastures and Forage Crops, 1946.) 2*s.* 6*d.* [44

Other Countries

B.A.N.Z. Antarctic Research Expedition, 1929–1931. Reports, Series B (Zoology and Botany). Vol. 1, Part 1: Biological Organization and Station List. By Dr. T. Harvey Johnston. Pp. ii + 48. 5*s.* 6*d.* Vol. 1, Part 2: Fishes. By J. R. Norman. Pp. 49–88. 5*s.* (Adelaide: Barr Smith Library, The University, 1937.) [132

B.N.A.Z. Antarctic Research Expedition, 1929–1931. Reports. Series B (Zoology and Botany). Vol. 2: Birds. By R. A. Falla. Pp. xiv + 288 + 4 plates. 50*s.* (Adelaide: Barr Smith Library, The University, 1937.) [132

B.N.A.Z. Antarctic Research Expedition, 1929–1931. Reports, Series B (Zoology and Botany). Vol. 4, Part 1: Collembola, by H. Womersley; Loricata, by B. C. Cotton; Brachiopoda, by B. C. Cotton; Coleoptera, by H. Womersley. Pp. 36 + 1 plate. 5*s.* Vol. 4, Part 2: Cumacea and Nebaliacea. By H. M. Hale. Pp. 37–56. 3*s.* Vol. 4, Part 3: Diptera, by H. Womersley; Miscellaneous Insecta, by H. Womersley; Lepidoptera, by H. Womersley and N. B. Tindale. Pp. 57–86 + plate 2. 4*s.* 6*d.* Vol. 4, Part 4: Polychæta. By C. C. A. Monro. Pp. 87–156. 9*s.* 6*d.* Vol. 4, Part 5: Opiliones and Aranеæ. By Dr. V. V. Hickman. Pp. 157–188. 4*s.* 6*d.* Vol. 4, Part 6: Crinoidea. By D. Dilwyn John. Pp. 189–212. 3*s.* 6*d.* (Adelaide: Barr Smith Library, The University, 1937–1939.) [132

A.A.A.S. Research Conference on Cancer. A Conference of Papers and Discussions presented at the Summer Meeting of the Section on Chemistry of the American Association for the Advancement of Science at Gibson Island, Maryland, July 31–August 4, 1944. Edited by Forest Ray Moulton. Pp. x+333. (Washington, D.C.: American Association for the Advancement of Science, 1945.) [182

Anthropological Papers of the American Museum of Natural History. Vol. 40, Part 1: Giant Early Man from Java and South China. By Franz Weidenreich. Pp. 134+12 plates. (New York: American Museum of Natural History, 1945.) [182

U.S. Department of Agriculture. Technical Bulletin No. 898: Susceptibility of Certain Strains of Field Corn in Hybrid Combinations to Damage by Corn Earworms. By F. F. Dicke and Merle T. Jenkins. Pp. 36. (Washington, D.C.: Government Printing Office, 1945.) 10 cents. [182

Anglo-American Caribbean Commission. An Experimental Fishery Survey in Trinidad, Tobago and British Guiana, with Recommended Improvements in Methods and Gear. By Richard T. Whiteleather and Dr. Herbert H. Brown. Pp. iv+130. (Washington, D.C.: Government Printing Office, 1945.) [252

Indian Central Jute Committee. Economic Research Bulletin No. 2: Jute Substitutes. By K. C. Basak; with an Appendix on Some Technological Aspects of Jute Substitutes, by C. R. Nodder. Pp. iv+48. (Calcutta: Indian Central Jute Committee, 1945.) 11 annas; 1*s.* [252

Kungl. Sjökarteverket, Stockholm. Ergebnisse der Beobachtungen des Magnetischen Observatoriums zu Lovo (Stockholm) im Jahre 1935. Von Sven Åslund. Pp. 103. Ergebnisse der Beobachtungen des Magnetischen Observatoriums zu Lovö (Stockholm) im Jahre 1936. Von Sven Åslund. Pp. 103. Ergebnisse der Beobachtungen des Magnetischen Observatoriums zu Lovö (Stockholm) im Jahre 1937. Von Sven Åslund. Pp. 30. Ergebnisse der Beobachtungen des Magnetischen Observatoriums zu Lovö (Stockholm) im Jahre 1938. Von Sven Åslund. Pp. 30. Ergebnisse der Beobachtungen des Magnetischen Observatoriums zu Lovö (Stockholm) im Jahre 1939. Von Sven Åslund. Pp. 30. Ergebnisse der Beobachtungen des Magnetischen Observatoriums zu Lovö (Stockholm) im Jahre 1940. Von Sven Åslund. Pp. 30. Ergebnisse der Beobachtungen des Magnetischen Observatoriums zu Lovo (Stockholm) im Jahre 1941. Von Sven Åslund. Pp. 28. Ergebnisse der Beobachtungen des Magnetischen Observatoriums zu Lovö (Stockholm) im Jahre 1942. Von Sven Åslund. Pp. 30. Ergebnisse der Beobachtungen des Magnetischen Observatoriums zu Lovö (Stockholm) im Jahre 1943. Von Sven Åslund. Pp. 30. (Stockholm: Kungl. Sjökarteverket, 1940–1945.) [252

East African Industrial Research Board. Second Annual Report, 1944. Pp. iv+22. (Nairobi: East African Industrial Research Board, 1945.) 1*s.* 6*d.* [272

Proceedings of the American Philosophical Society. Vol. 90, No. 1, January 29, 1946: Symposium on Atomic Energy and its Implications. Papers read at the Joint Meeting of the American Philosophical Society and the National Academy of Sciences, November 16 and 17, 1945. Pp. iii+80. (Philadelphia: American Philosophical Society, 1946.) [53

U.S. Department of Agriculture: Bureau of Entomology and Plant Quarantine. Picture Sheet No. 6: Gladiolus Thrips. Pp. 2. 5 cents. Picture Sheet No. 7: Striped Cucumber Beetle. Pp. 2. 5 cents. Picture Sheet No. 8: Potato Leafhopper. Pp. 2. 5 cents. Picture Sheet No. 9: Imported Cabbage Worm. Pp. 2. 5 cents. Picture Sheet No. 10: Squash Borer. Pp. 2. 5 cents. Picture Sheet No. 12: Fall Armyworm. Pp. 2. 5 cents. (Washington, D.C.: Government Printing Office, 1941.) [53

Bulletin of the History of Medicine. Supplement No. 5: Public Baths and Health in England, 16th–18th Century. By Charles F. Mullett. Pp. iii+85. (Baltimore, Md.: Johns Hopkins Press, 1946.) 1.50 dollars. [53

Journal of Colloid Science. Published bi-monthly. Vol. 1, No. 1, January. Pp. 126. (New York: Academic Press, Inc., 1946.) 10 dollars a year. [53

MURDOCH TRUST

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SUDAN GOVERNMENT

Research Division, Department of Agriculture and Forests requires an Economic Botanist for service in the Sudan. Applicants who should be between 22½ and 45 years of age should possess a good University degree or its equivalent in Natural Science or Agriculture with specialization in botany essential. Duties will include research on weed control, introduction and improvements to existing crops, identification of Sudan Flora, etc., and may involve work in any part of the Sudan. Pensionable scale of the post ranges from £E. 480 to £E. 1,080 (£E. 1 equals £1 0s. 6d.) which could be increased by 15 to 25 per cent for Provident Fund and Short Term Contract rates. Appointment will be on Short Term Contract (initially for two years) without post service benefits, or possibly on Provident Fund Contract (with security for seven or more years after probationary period). In certain special instances a candidate under 35 years of age may be offered a probationary contract with the view to pensionable service. Starting rates would be determined according to age, qualifications and experience. An Outfit Allowance at the rate of £E. 60 is payable when contract is signed provided salary on appointment does not exceed £E. 600 pensionable, £E. 700 Provident Fund or £E. 800 Short Term Contract. A cost of living allowance at the rate of 35 per cent of pay, subject to a maximum of £E. 15 per mensem is now payable on all salaries up to £E. 1,200 per annum. A progressively reduced allowance is payable to officials on higher salaries. At present there is no income tax payable in the Sudan. Strict medical examination. Free passage on appointment.

Papers containing full information for candidates are obtainable from the Sudan Agent in London, Wellington House, Buckingham Gate, London, S.W.1, England. Envelopes to be marked "Economic Botanist—168."

COMMONWEALTH OF AUSTRALIA

COUNCIL FOR SCIENTIFIC AND INDUSTRIAL RESEARCH
DIVISION OF INDUSTRIAL CHEMISTRY
APPOINTMENT (NO. 957) OF OFFICER FOR CERAMICS RESEARCH

Applications are invited for appointment to a position of either Principal Research Officer or Senior Research Officer, Division of Industrial Chemistry, Melbourne, Australia. Duties: to engage in the development of a Section of Ceramics Research. Qualifications: University degree, preferably with honours, in science with chemistry as a major subject, or equivalent qualifications, with advanced training in mineralogy, inorganic chemistry or physical chemistry. Research experience is essential. Salary: dependent on qualifications and experience, commencing salary will be determined within the range of Principal Research Officer (£A796–£A940 p.a. actual; four equal increments, first automatic, remainder discretionary) or Senior Research Officer (£A665–£A790 p.a. actual; five equal increments, first automatic, remainder discretionary). The above actual salaries include cost-of-living adjustment (at present an additional £A40 p.a.). Note: salary will commence from the date the successful applicant takes up duty in England, if required to do so, or one fortnight before scheduled date of departure for Australia, whichever is the earlier, and will be paid in sterling until embarkation for Australia; thereafter in Australian currency. Fares (including those of wife and family) to Australia will be paid. Subject to a satisfactory medical examination the appointee will be eligible to contribute to, and receive benefits from, either the Commonwealth Superannuation Fund or the Commonwealth Provident Account.

Applications, referring to appointment No. 957, and stating date of birth, nationality, present employment, particulars of qualifications and experience, accompanied by copies of not more than four testimonials, should reach the undersigned not later than October 4, 1946.

(Sgd.) LEWIS LEWIS,
Secretary,
Australian Scientific Research Liaison Office,
Australia House, Strand, London. W.C.2.

Physicists and chemists for research work on glass and glass fibres. Aged 26–30, preferably with a few years' experience in academic or industrial research. Salary according to age and qualifications. Apply to Box 678, T. G. Scott & Son, Ltd., 9 Arundel Street, London, W.C.2.

UNIVERSITY OF MELBOURNE

DEPARTMENT OF SOCIAL STUDIES

Applications are invited for the following positions: Lecturer and Field Work Supervisor. Salary £400–£550 (Australian) (plus cost of living adjustment, at present £48 (Aust.) per annum), commencing rate according to qualifications and experience. Duties will include lecturing in social case work, arrangement of students' field work, direct supervision of the field work of some students and guidance of supervision to supervisors in social agencies. Applicants should be qualified social workers with training and experience in family case work or preferably child guidance. University degree desirable.

Senior Demonstrator (Group Work Supervisor). Salary £350–£400 (Aust.) (plus cost of living adjustment, at present £48 (Aust.) per annum), commencing rate according to qualifications and experience. Applicants should be qualified and experienced youth leaders. Duties will include some lecturing in group work, arrangement of students' field work in youth clubs and the direct supervision of the field work of some students.

Each appointment will be for initial period of three years to commence March, 1947, subject to renewal by mutual agreement. The University will meet expense of travel to Melbourne and return fare if appointment is given up at the end of the 3 year period. Further particulars may be obtained from the Secretary, Universities Bureau of the British Empire, 24 Gordon Square, London, W.C.1. Closing date for receipt of applications September 30, 1946.

MANCHESTER MUNICIPAL COLLEGE OF TECHNOLOGY

(FACULTY OF TECHNOLOGY IN THE UNIVERSITY OF MANCHESTER

The Governing Body invites applications for the following: An Assistant Lectureship in Mathematics; an Assistant Lectureship in Physics; an Assistant Lectureship in Mechanical Engineering (Drawing office experience and interest in research desirable); an Assistant Lectureship in Modern Languages (with suitable qualifications in French and/or German). The appointments will carry the title and status of Assistant Lecturer in the University of Manchester. Present salary scale: £352 per annum rising by annual increments of £25 to £452 per annum. This scale, however, is subject to additions which are now awaiting Ministry approval. Superannuation is covered by the F.S.S.U. scheme.

Conditions of appointment and form of application may be obtained from the Registrar, College of Technology, Manchester, 1. The last date for the receipt of applications is Monday, September 9, 1946. Canvassing, either directly or indirectly, will disqualify a candidate for appointment.

J. E. MYERS,
Principal of the College.

MIDDLESBROUGH EDUCATION COMMITTEE

CONSTANTINE TECHNICAL COLLEGE

PRINCIPAL: H. V. FIELD, B.Sc., WH.SCH., M.I.E.E.

Applications are invited for the post of full-time Lecturer in Metallurgy, to commence duties on September 1, or as soon as possible after that date. Candidates should be graduates in Metallurgy or possess equivalent qualifications, and preferably have had some industrial experience. Salary in accordance with the Burnham Technical Scale. Application forms and further particulars obtainable from the undersigned, to whom the completed forms should be returned as soon as possible.

STANLEY HIRST,
Director of Education.

Education Offices,
Middlesbrough.

THE UNIVERSITY OF MANCHESTER

Applications are invited for the post of Lecturer in Experimental Physiology. Candidates must hold a registrable medical qualification. Stipend £650 per annum. Duties to commence as soon as possible after September 29, 1946. Applications should be sent, not later than September 27, to the Registrar, The University, Manchester, 13, from whom further particulars may be obtained.

RESEARCH BURSARIES

Applications are invited for two research bursaries granted by the British Iron and Steel Research Association for research on the Physical Chemistry of Steelmaking. Both bursaries of £250 per annum are tenable at the Imperial College of Science and Technology. They will be awarded for one year in the first instance, but since they are intended for students studying for higher degrees they will normally be extended for a second year.

Applications giving qualifications and experience should be made to the Personnel Officer, British Iron and Steel Research Association, 11 Park Lane, London, W.1.

COLLEGE OF TECHNOLOGY MANCHESTER

BRADFORD DYERS' ASSOCIATION RESEARCH FELLOWSHIP

Applications are invited for a Fellowship established by the Bradford Dyers' Association, Ltd., for research on fundamental problems in the industrial processing of textiles, and tenable in the Department of Textile Chemistry. The investigations may be concerned, for example, with the chemistry and physics of dyeing or allied processes, or with the design and performance of processing machinery. The applicant should possess high scientific qualifications; experience in the industry is not essential. The value of the Fellowship is £600 per annum and it will be held, in the first instance, for one year.

Form of application may be obtained from the Registrar, College of Technology, Manchester, 1. The last date for the receipt of applications is September 30, 1946.

J. E. MYERS,
Principal.

THE UNIVERSITY OF LIVERPOOL

Applications are invited for the following posts and one Scholarship in the Department of Zoology:

(i) Lecturer for Fisheries work at the Port Erin Station, Grade II, Salary £450–£600, according to qualifications and experience, with participation in Federated Superannuation System for Universities. Research experience in Fishery work is required for this post.

(ii) Research Assistant, for which post knowledge of some branch of Biology and of Mathematics is required. Salary not less than £350, according to qualifications and experience, with participation in Federated Superannuation System for Universities.

(iii) The Herdman Scholarship value £200 per annum, renewable for a second year, for research in Marine Zoology at the Port Erin Biological Station.

Applications, which should include particulars as to age, academic qualifications and experience, together with testimonials and names of two referees for posts (i) and (ii), should be forwarded to the undersigned, from whom further particulars may be obtained, not later than September 15. Service candidates may apply by air mail to be followed by full particulars.

STANLEY DUMBELL,
Registrar.

THE UNIVERSITY OF SHEFFIELD

Applications are invited for two vacancies in the scientific staff of the University Department of Glass Technology, one for a Research Chemist, the other for a Research Physicist. Candidates for the chemical post should have special knowledge of Inorganic and Physical Chemistry, and those for the Physical post should preferably have experience in the generation and use of ultra high frequency electromagnetic waves. Research experience is essential in both cases, but candidates need not have previous experience of glass. Initial salary £450 per annum, with superannuation provision under the Federated Superannuation Scheme for Universities, and with certain family allowances.

Applications (three copies) including the names and addresses of three referees, and, if possible, copies of testimonials, should reach the undersigned (from whom further particulars may be obtained) not later than September 28, 1946.

A. W. CHAPMAN,
Registrar.

THE UNIVERSITY OF LIVERPOOL

Applications are invited for a Lectureship in Applied Mathematics. The appointment will be in Grade II (Salary £450–£600) or Grade III (salary £350–£450) according to qualifications, experience, and other relevant circumstances.

The duties of the Lecturer will begin in October 1946, or as soon after that as possible, but the University will consider applications from candidates in the Forces, or engaged upon other national service, even though they may have no immediate prospect of release.

Applications, stating age, academic qualifications and experience, together with three testimonials, should be received not later than September 14, 1946, by the undersigned, from whom further particulars may be obtained.

STANLEY DUMBELL,
Registrar

BIRKBECK COLLEGE

(UNIVERSITY OF LONDON)

It is proposed to proceed to the appointment of a Lecturer (Grade III) in the Department of Geography (annual salary not less than £400 per annum).

Applications must be received not later than September 14, addressed to the Clerk, Birkbeck College, E.C.4.

COUNTY BOROUGH OF ROTHERHAM EDUCATION COMMITTEE

COLLEGE OF TECHNOLOGY

PRINCIPAL: F. C. CLARKE, Esq., B.Sc., A.R.C.Sc., A.M.I.E.E.

Applications are invited for the post of Lecturer in the Department of Metallurgy and Chemistry, to teach at least one branch of Chemistry to degree standard. Ability to take some Metallurgical subjects is also desirable. A knowledge of Microchemistry would be an added recommendation. Applicants should possess graduate qualifications in Chemistry. Duties to commence in September, or as soon after as possible. Salary will be in accordance with the new Burnham Technical scale with such additions for industrial experience and qualifications as are approved by the Ministry of Education.

Further particulars and application forms may be obtained from the undersigned and should be returned as soon as possible.

J. A. MAIR,
Director of Education.

Education Offices,
Rotherham.

NORTH OF ENGLAND JOINT CANCER ORGANIZATION

NEWCASTLE UPON TYNE

Applications are invited for the post of Assistant Physicist for duties in the X-ray and Radium Department of the above organization. Applicants should have an honours degree in physics, and preferably have had some experience of research work. Previous hospital experience is not essential. Salary commencing £450 per annum, rising by £25 to £600. The appointment is to be terminable by one month's notice from either side, and is conditional on passing a medical examination to comply with the Local Government Superannuation Act, 1937. Applications giving particulars of age, experience, and names of three persons to whom reference may be made, should reach me not later than September 21.

JOHN ATKINSON,
Town Clerk and Hon. Secretary
of the Joint Cancer Committee.

Town Hall,
Newcastle upon Tyne.

HALIFAX MUNICIPAL TECHNICAL COLLEGE

PRINCIPAL: B. R. HEASMAN, M.Sc.(LOND.), A.R.I.C.

Applications are invited for the post of Head of the Chemistry Department, duties to commence on January 1, 1947. Candidates must have high qualifications in Chemistry with some teaching, industrial and organizing experience. Ability to organize research will be an added recommendation. Salary in accordance with Grade I of Burnham (Technical) Report (£600 × £25–£750 p.a.). Previous experience of a similar kind will be taken into account in assessing the commencing salary. For further particulars apply to the Principal, Municipal Technical College, Hopwood Lane, Halifax. Applications should be forwarded to the undersigned on or before Monday, September 9, 1946.

C. E. GENT,
Chief Education Officer.

West House,
Halifax.

THE SIR JOHN CASS TECHNICAL INSTITUTE

JEWRY STREET, ALDGATE, E.C.3

Day and Evening Courses in Chemistry, Physics, Mathematics, Botany, Metallurgy, in preparation for Intermediate Science, B.Sc.(General), B.Sc. (Special) and B.Sc. Eng.(Metallurgy) examinations of the University of London under recognised teachers of the University. Post-graduate courses and research for M.Sc. and Ph.D. degrees.

The following special courses will also be held: Mathematical Physics, Illumination, X-Ray Spectroscopy and its applications, Microchemistry, Spectroscopy, Chemical Plant, Electro-Chemical Analysis, Chemistry of the Less Familiar Elements, Postgraduate Organic Chemistry, Coal Carbonisation and Gas Engineering, Industrial Law.

New Session opens—September 23, 1946.

Full particulars and copy of prospectus on application to the Principal.

THE UNIVERSITY OF LIVERPOOL

Applications are invited for Lectureships now vacant in the Department of Physics. Salary according to qualifications and experience.

Applications, which should include particulars as to age, academic qualifications and experience, together with copies of testimonials and the names of three referees, should be received not later than September 14 by the undersigned, from whom further particulars may be obtained.

STANLEY DUMBELL,
Registrar.

UNIVERSITY OF BRISTOL

DEPARTMENT OF AGRICULTURE AND HORTICULTURE

LONG ASHTON, BRISTOL.

Applications are invited for the post of Organic Chemist now vacant at Long Ashton Research Station. The appointment is in connection with investigations on Mineral Deficiencies of Plants, financed by special grants made by the Agricultural Research Council. Commencing salary will vary according to experience but will not exceed £490 per annum. Candidates should possess a University Degree with Honours (or equivalent) and should have had research experience in Organic Chemistry.

Further particulars may be obtained from the undersigned, to whom applications, with copies of three recent testimonials, should be addressed not later than September 21, 1946.

WINIFRED SHAPLAND, M.A.,
Secretary and Registrar.

The University,
Bristol.

THE UNIVERSITY OF SHEFFIELD

Applications are invited for the post of Lecturer in Microbiology in the Department of Bacteriology. Salary £600–£800 according to experience, with superannuation provision under the Federated Superannuation Scheme for Universities, and with marriage and children's allowances. The successful candidate will be required to begin his duties as early as possible in the Autumn term, 1946. Applications (three copies) including the names and addresses of referees, and, if desired, copies of testimonials, should reach the undersigned (from whom further particulars may be obtained) not later than October 21, 1946.

A. W. CHAPMAN,
Registrar.

THE UNIVERSITY OF LIVERPOOL

Research Assistants, Workshop Technicians and Draughtsmen required in the Department of Physics. Salary according to qualifications and experience.

Applications, which should include particulars as to age, qualifications and experience, together with copies of testimonials, should be received not later than September 14 by the undersigned, from whom further particulars may be obtained.

STANLEY DUMBELL,
Registrar.

MASSEY AGRICULTURAL COLLEGE

(UNIVERSITY OF NEW ZEALAND)

PALMERSTON NORTH, NEW ZEALAND

LECTURER IN DAIRY TECHNOLOGY

Applications, closing October 1, are invited for the position of Lecturer in Dairy Technology. Commencing salary £675 per annum (New Zealand currency) plus £13 cost of living allowance, with a maximum of £825 per annum.

Conditions of appointment may be obtained from the High Commissioner for New Zealand, 415 Strand, London, W.C.2.

UNIVERSITY COLLEGE OF SOUTH WALES AND MONMOUTHSHIRE

The Council of the College invites applications for the post of Lecturer in the Department of Anatomy (sub-Department of Histology and Embryology). Salary at the rate of £650 per annum. The appointment will be for two years in the first instance. Further particulars may be obtained from the undersigned by whom applications should be received not later than September 16, 1946.

(Signed) LOUIS S. THOMAS,
Registrar.

Cathays Park, Cardiff.

ROYAL VETERINARY COLLEGE AND HOSPITAL

COURTAULD CHAIR OF ANIMAL HUSBANDRY, VETERINARY HYGIENE AND DIETETICS

The Council invites applications for the above professorship. Salary £1,400 per annum with superannuation benefits under the Federated Superannuation Scheme for Universities.

Applications should be sent not later than September 23, 1946, addressed to the Principal, Royal Veterinary College and Hospital, London, N.W.1.

THE UNIVERSITY OF MANCHESTER

The next session commences on Thursday, October 3.

Roche Products, Ltd., Welwyn Garden

City, require the services of research chemists with post-graduate research experience in organic chemistry. Salary according to qualifications. Apply to Director of Research.

BIRMINGHAM UNITED HOSPITAL

THE GENERAL HOSPITAL

THE QUEEN ELIZABETH HOSPITAL

(ALSO INCORPORATING THE QUEEN'S HOSPITAL 1840–1941)

ASSISTANT PHYSICIST TO THE BIRMINGHAM NATIONAL RADIUM CENTRE

There is a vacancy for an Assistant Physicist to the Birmingham National Radium Centre. Salary in accordance with the recommendations of the Hospital Physicists' Association. For further particulars apply to the undersigned.

G. HURFORD,
Secretary, Birmingham United Hospital.

The Queen Elizabeth Hospital,
Birmingham, 15.

NORTHERN POLYTECHNIC

HOLLOWAY, N.7

The Governing Body invite immediate applications from Graduates of a British University for the post of Lecturer of Botany, to take classes in Botany to B.Sc. (General) standard and Biology to Intermediate Science standard. Salary in accordance with the Burnham Technical Scale, plus London allowance. The post will be considered for the award of an allowance (for men not less than £50 and not more than £100; for women not less than £40 and not more than £80) over and above the scale salary in respect of special responsibilities. Experience in research and the teaching of students of University standard is essential. Application forms, together with full particulars, will be forwarded on receipt of a stamped, addressed foolscap envelope.

R. H. CURRELL,
Clerk.

NORTHERN POLYTECHNIC

HOLLOWAY, N.7

The Governing Body invite immediate applications from graduates of a British University for the following full-time appointments:

(1) Lecturer in Chemistry to teach chemistry to Intermediate Science standard, and Inorganic or Organic Chemistry to Degree standard.

(2) Lecturer in Physics and Mathematics to teach physics and mathematics to Intermediate standard, and physics to General Degree standard.

It is desirable but not essential, that applicants should possess some teaching experience. Salary in accordance with the Burnham Technical Scale, plus London allowance.

Application forms, together with full particulars, will be forwarded on receipt of a stamped addressed foolscap envelope. These should be returned within two weeks of the publication of this advertisement.

R. H. CURRELL,
Clerk.

NORTHERN POLYTECHNIC

HOLLOWAY, N.7

The Governing Body invite immediate applications from graduates of a British University for the following evening lectureships. Classes are held from 6.0–9.0 and the fee per evening is given in brackets after each subject.

Intermediate Chemistry	37s.
Intermediate Physics	37s.
Intermediate Pure Mathematics (for 2 hours)	27s.
Intermediate Applied Mathematics (for 2 hours)	27s.
Intermediate Botany	37s.
Intermediate Zoology	37s.
Intermediate Biology	37s.
Matriculation Mathematics	29s.
Matriculation Physics	29s.
Plastics Technology	37s.

Applications should be sent within two weeks of the publication of this advertisement.

R. H. CURRELL,
Clerk.

LONDON COUNTY COUNCIL

MENTAL HEALTH SERVICES

Applications are invited for the appointment of Junior Biochemist at the Teaching and Research Laboratory in the Maudsley Hospital Post-Graduate Medical School, Denmark Hill, London, S.E.5. The person appointed will be required to engage in biochemical research work in relation to electroencephalographic studies. Salary £300 rising to £500 a year, plus cost-of-living addition. Commencing salary according to experience. Application form, returnable by September 22, 1946, from Medical Officer of Health (B), Mental Health Services, County Hall, Westminster Bridge, S.E.1. (2036)

THE POLYTECHNIC

309 REGENT STREET, W.1

A course of six lectures on General Rheology will be given by Dr. G. W. Scott Blair, on Tuesday evenings from 7 to 8.30, commencing October 8, 1946. Fee, 15s.

Detailed syllabus and enrolment form may be obtained on application by letter addressed to the Head of the Department of Mathematics and Physics.

(*Continued on page* lxxviii)

(*Continued from page* lxxvii)

BRITISH WELDING RESEARCH ASSOCIATION

Engineering research assistants required, with honours degree in civil or mechanical engineering and preferably with two or three years industrial experience. Research experience an advantage. The post will be subject to superannuation under the F.S.S.U. Scheme. Applications should be addressed to the Director of Research, British Welding Research Association, 29 Park Crescent, London, W.1.

BRITISH WELDING RESEARCH ASSOCIATION

Senior Structural Engineer required thoroughly conversant with current structural steelwork practice to assist in the development of a method of design for welded structures. Some research experience will be an advantage. The officer will reside in Cambridge. Salary up to £1,200 according to qualifications and experience. The post will be subject to superannuation under the F.S.S.U. Scheme. Applications should be addressed to the Director of Research, British Welding Research Association, 29 Park Crescent, London, W.1.

The University Court of the University of St. Andrews invites applications for the post of Lecturer in the Department of Pathology in the Medical School, Dundee. Commencing salary according to experience £450–£600 with superannuation provision, and a supplementary payment of £100 p.a. in respect of special duties. Applications will be considered from candidates in H.M. Forces. Applicants whose main interest is Chemical Pathology will be preferred. Applications with two recent testimonials and the names of two referees should be lodged with the undersigned, from whom a statement of conditions of appointment may be obtained. Closing date November 16, 1946.

DAVID J. B. RITCHIE,
Secretary, The University, St. Andrews.

Aero Engine Manufacturers have a position for an Electronic Engineer to specialize on measurement on vibration and allied problems in development department. Reply, giving particulars of technical training, experience and salary required to Box 679, T. G. Scott & Son, Ltd., 9 Arundel Street, London, W.C.2.

Research Assistant.—To conduct applied Research on pilot and full scale plants in Chemical Engineering with reference particularly to the treatment of gases including cooling, scrubbing, and suspended particle removal. High academic ability as indicated by good honours degree in chemistry, physics, engineering or chemical engineering, combined with considerable practical aptitude, is essential. Age around 25. Some research experience desirable but not essential. Apply, stating age and full particulars of education, qualifications and experience to Whessoe, Ltd., Darlington, Co. Durham.

The Medical College, St. Bartholomew's Hospital, in the City of London, West Smithfield, E.C.1. Applications are invited for the post of grade B Technician in the Physiology Laboratory. Salary in accordance with the B.H.A. scale, commencing at £300 per annum. Applicants must be skilled in Histology and will be required to commence duties as soon as possible. Communications should be addressed to the Dean, from whom further particulars may be obtained.

Glass Technician, preferably with knowledge of scientific glass-work production, required by well-known scientific instrument manufacturers for interesting development work. Applicants should be capable of controlling labour and production when the development work has been established and be appreciative of and capable of assisting in the application of new techniques in glassworking. Permanent and progressive post for a young ambitious man of character and ability. Address full particulars of training, experience, salary expectations, etc., to Box 677, T. G. Scott & Son, Ltd., 9 Arundel Street, London, W.C.2.

An important administrative position is available for a man whose all-round experience and capacity are such as would fit him for a high class Managing Directorship and who has a good commercial and technical experience in the field of industry which embraces the production and sale of paints, media, enamels, varnishes, industrial finishes. Only applicants able to justify high remuneration will be considered.

Apply, giving qualifications, experience, age, etc., in confidence to Box 675, T. G. Scott & Son, Ltd., 9 Arundel Street, London, W.C.2.

Laboratory Assistant (Grade II) required in September for the Biology Department. Salary £2 10 per week, rising by annual increments of 5s. per week to £5. Pension scheme in operation.

Apply as soon as possible, with particulars of qualifications and experience, to the Secretary, King's College of Household and Social Science (University of London), Campden Hill Road, London, W.8.

University of London.—The Senate invite applications for an Examinership in General Biology for the First Examination for Medical Degrees in the Calender year beginning January 1, 1947. Applications must be received not later than October 1, 1946, by the External Registrar, University of London, Senate House, W.C.1, from whom further particulars and forms of application may be obtained.

Factory situated East London requires a Research Chemist with experience in industrial organic chemistry and all round training and knowledge of physico-chemical methods desirable. Salary £600–£700 per annum, according to qualifications. Box 676, T. G. Scott & Son, Ltd., 9 Arundel Street, London, W.C.2.

Man aged 20 to 25 years, with B.Sc. (Engineering) or Higher National Certificate in electrical engineering required for investigation and testing of high voltage power cables and accessories. Salary £300 to £400 according to qualifications. Apply Staff Officer, British Insulated Callender's Cables, Ltd., Belvedere, Kent, quoting ref. SR/8.

Glassblower wanted for industrial electronics laboratory located 50 miles London. Experience in vacuum work, glass-metal seals, lathe and bench work required. Write stating experience and salary expected to Box 674, T. G. Scott & Son, Ltd., 9 Arundel Street, London, W.C.2.

Microscopes and other relative instruments, accessories and books on the subject. List free. Chards (established 1869), Forest Hill, S.E.23. Phone Forest Hill 5946 and Springpark 1629.

FINAL REPORT

NUTRITIONAL INVESTIGATIONS IN MAURITIUS 1942–45

Obtainable from the Crown Agents and the Government Printer, Mauritius.

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